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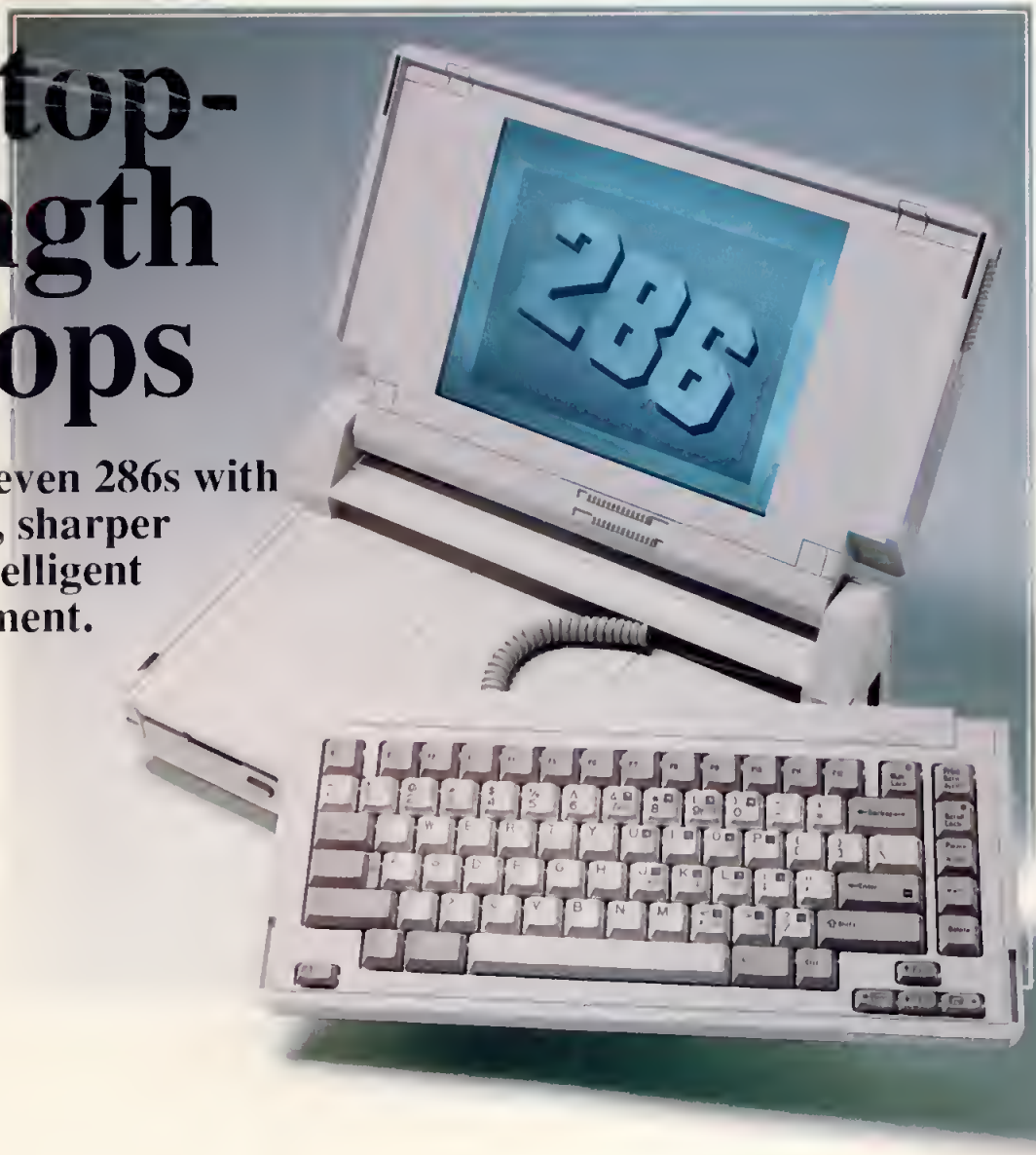

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Side

Top

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CIRCLE 153 ON READER SERVICE CARD

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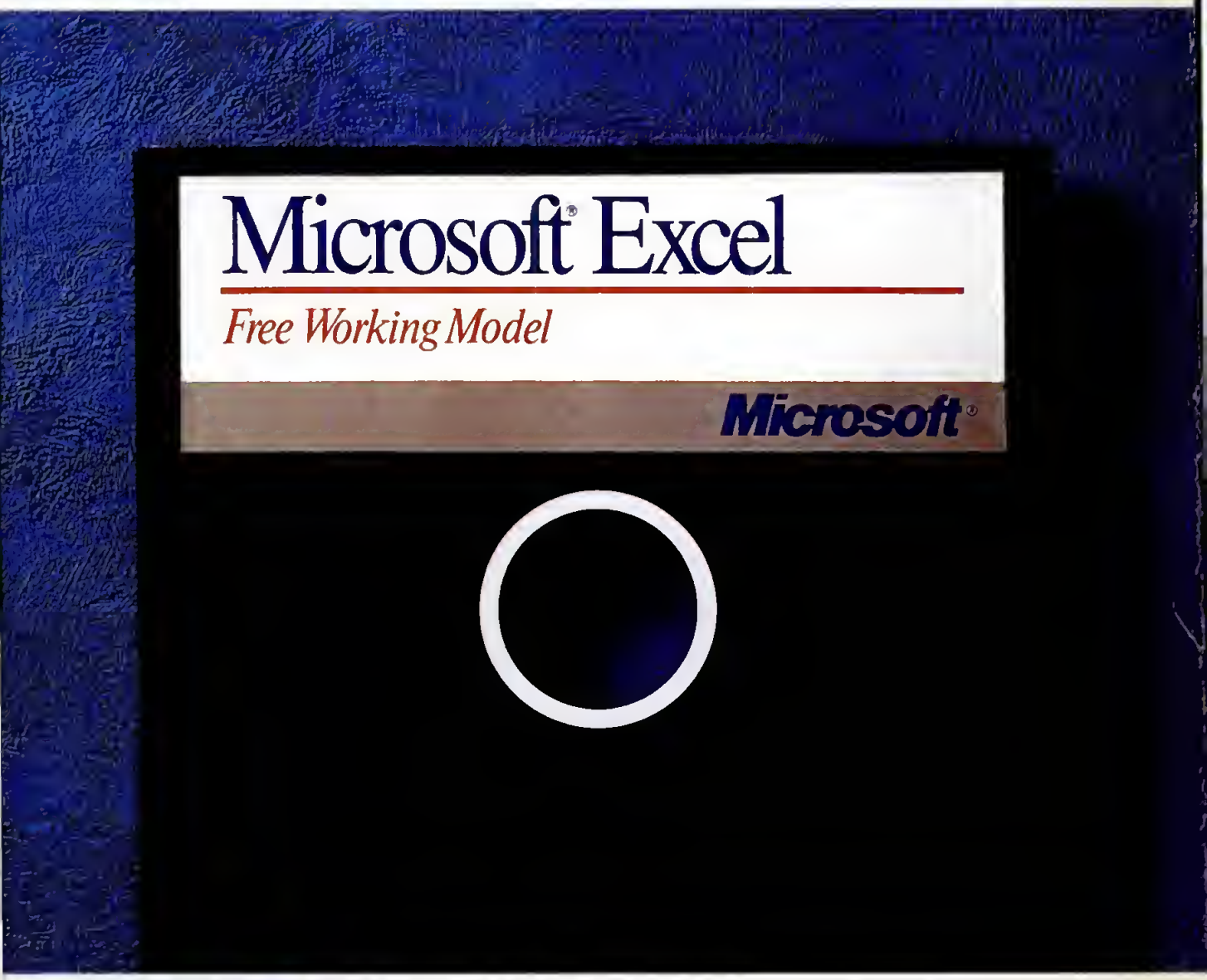

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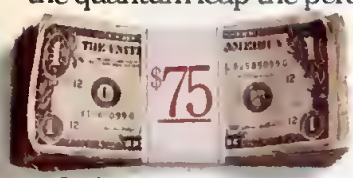
At this point, we could tell you all about the quantum leap the personal computer industry is taking—more specifically the leap away from character-based environments and toward graphical environments like Windows and OS/2 Presentation Manager.



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CIRCLE 180 ON READER SERVICE CARD

Inside

It looks harmless enough, but the TAS equipment that project leader Bob Kane is standing beside is designed to generate impairments. Though Kane and writers M. David Stone and Ross Greenberg remain unscathed after spending hundreds of hours holed up in the PC Labs Beta Test Center with it, the TAS equipment produced problems that proved deadly to many of the modems it was used to test.

TAS (an acronym for Telecom Analysis Systems) is the name of both the machines and their manufacturer. The company was founded by ex–Bell Labs employees in 1984, after the divestiture of the phone system. Five years later, its machines—capable of generating the signals characterizing virtually any telephone-line condition—rigorously test the products of "practically every major modem manufacturer," according to company president David Tarver.

Bob Kane and TAS: the man and machine behind the PC Labs modem shoot-out.

We followed a proposed Electronic Industries Association standard to test the asynchronous 2,400-bit-per-second MCA modems reviewed in this issue. We used the TAS Voiceband Channel Simulator to generate seven stressful line conditions; the TAS Modem Test Unit told us how well the modems performed. The information we gleaned from the $27,950 combination of equipment led us to drop many of the 20 modem cards we originally set out to review.

It is *PC Magazine*'s policy to inform product manufacturers of serious problems with review equipment. When they learned of their products' inability to perform acceptably on one or more of the line conditions, the modems' makers quietly withdrew them. It seems that, for some reason, it's more difficult to create modem cards to work with the MCA bus than with the AT bus. Thanks to our rigorous machine-aided testing procedures, you can feel confident that the MCA modems we review here are the ones that perform well.

Also evaluated—though not by such an automated method—are 7 286-based battery-operated laptops; 15 16-bit Super VGA cards; 14 data switches; and *SuperCalc5*, the latest version of the nearly-10-year-old spreadsheet package.

In our eyes, *PC Magazine* has always been Number 1. That judgment was echoed by the Computer Press Association, which has named *PC Magazine* "Best Computer Magazine, Circulation over 50,000," for the second straight year. The CPA said that *PC Magazine* "leaves no standard untumed in testing, analyzing, and evaluating computers, software, and peripherals....*PC Magazine* [is] a standard for the publishing industry." Executive editor Bill Howard was also honored for 1988's best feature, an article on laptops.—**Kellyn S. Betts** ■

PHOTOGRAPH: THOM O'CONNOR

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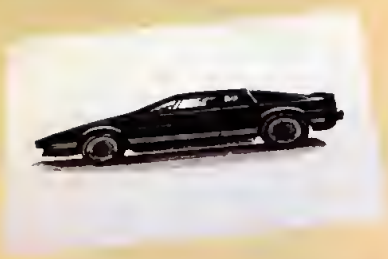

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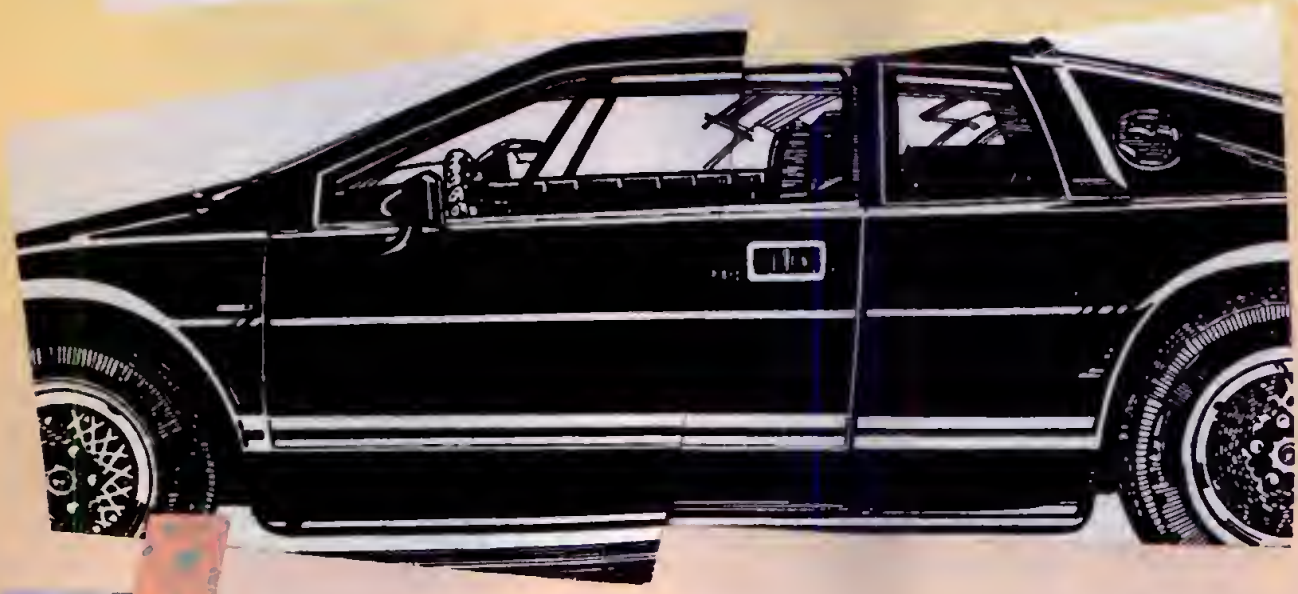

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CIRCLE 259 ON READER SERVICE CARD

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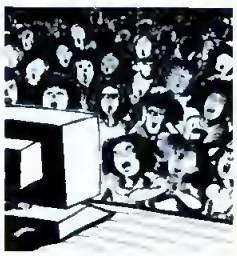

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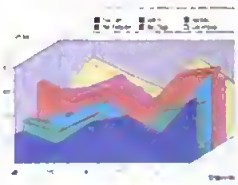

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PC MAGAZINE REVIEWS
Except where noted: All *PC Magazine* reviews are of currently available products. Comparative reviews are arranged alphabetically by product name for software, by company name for hardware. Software is free from copy protection. On benchmark test charts, shorter bars indicate faster products (less time to complete a task). Benchmark and performance tests are run on 8-MHz IBM PC ATs.

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InfoWorld "Report Card," 6/27/88.
PC Week reader poll, 10/31/88.

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PC MAGAZINE SAYS, JANUARY 31, 1989

"In short: Austin Computer Systems has a winning combination of classy parts, smart design, high performance, and aggressive pricing, all backed by a GE on-site service contract. How can you lose?"

Austin 286/12.5 Cache Standard Features:

- Intel 12.5 MHz 80286 Processor
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- 16 Bit Paradise EEGA Autoswitch Display Adapter
- 40 MB-25 ms Super Fast Access Hard Drive
- 1:1 Fast Transfer Interleaving Controller Card
- 32K High Speed Hard Disk Cache
- Super PC Kwik Disk Caching Software
- 1 MB RAM (expands to 4 MB on board, 16 MB total)
- Shadow RAM Caching (BIOS Caching)
- EMS LIMM 4.0 Support
- American-Made MotherBoard
- 3.5" 1.44 or 5¼" 1.2 MB Floppy Disk Drive
- Phoenix BIOS
- Keytronics Enhanced 101 Keyboard
- 2 Serial Ports & 1 Parallel Port
- 1 PS/2 Mouse Port
- Clock with Battery Backup
- 80287 Math Co-Processor Socket
- FCC Class B Approved
- Users & Technical Reference Manual
- Built-in Setup & Diagnostics Program
- Fully DOS & OS/2 Compatible

Austin 286/12.5 Price Matrix		
Choose Monitor Below	Choose Hard Drive Below	Price
Hercules Monochrome	40 MB HD (25 ms 1:1)	$1895
	80 MB HD (28 ms 1:1)	$2095
EGA Color 640×350	40 MB HD (25 ms 1:1)	$2195
	80 MB HD (28 ms 1:1)	$2395
VGA Monochrome	40 MB HD (25 ms 1:1)	$2195
	80 MB HD (28 ms 1:1)	$2395
VGA Color 640×480	40 MB HD (25 ms 1:1)	$2395
	80 MB HD (28 ms 1:1)	$2595
Pro VGA Color 800×600	40 MB HD (25 ms 1:1)	$2595
	80 MB HD (28 ms 1:1)	$2795

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The Austin 286/20 Cache iocludes a VGA color monitor, 16 bit VGA color adapter, 40 MB-28 ms 1:1 hard drive, GE 1 year on-site service, 1 MB RAM, shadow RAM cache, Super PC Kwik disk cache software, 1.2 MB 5¼" floppy drive, 101 keyboard, and a full array of I/O ports.

Complete at **$2695**

The Austin 386/SX includes a VGA color monitor, 16 bit VGA color adapter, 40 MB-28 ms 1:1 hard drive, GE 1 year on-site service, 1 MB RAM, Super PC Kwik disk cache software, 1.2 MB 5¼ floppy drive, 101 keyboard, and a full array of I/O ports.

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The Austin 386/20 Cache includes a 64K static RAM cache, VGA color monitor, 16 bit VGA color adapter, 80 MB-28 ms 1:1 hard drive, GE 1 year on-site service, 1 MB RAM, Super PC Kwik disk cache software, 1.2 MB 5¼" floppy drive, 101 keyboard, and a full array of I/O ports.

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NEW PRICE

NEW SYSTEM

The Austin 386/33 Cache includes a 32K static RAM cache, VGA color monitor, 16 bit VGA color adapter, 157 MB-17 ms ESDI hard drive, GE 1 year on-site service, 1 MB RAM, shadow RAM cache, Super PC Kwik disk cache software, 1.2 MB 5¼" floppy drive, 101 keyboard, and a full array of I/O ports.

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If you're not satisfied for any reason, just return your system within 30 days for a full refund on the hardware price.

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We configure every Austin computer to include a Monitor, Video Adapter, Hard Drive, Floppy Drive, Keyboard, and a full array of I/O ports . . . If you desire a custom configuration, or additional options, just tell our sales personnel how you want it!

Austin Computers Price Matrix Chart

Choose System Size Below	Choose Hard Drive Below	Choose Monitor Below (Includes 16 Bit VGA Adapter Card)		
		VGA Mono-Chrome 640 × 480	VGA Color 640 × 480	Pro VGA Color 800 × 600
286/16	40 MB-28 ms 1:1	$2395	$2595	$2795
	100 MB 25 ms 1:1	$2795	$2995	$3195
286/20	40 MB-28 ms 1:1	$2195	$2695	$2895
	80 MB-28 ms 1:1	$2795	$2995	$3195
	157 MB-17 ms ESOI	$3295	$3195	$3695
386/SX	40 MB-28 ms 1:1	$2495	$2695	$2893
	80 MB-28 ms 1:1	$2695	$2995	$3195
	157 MB-17 ms ESOI	$3195	$3395	$3595
386/20	40 MB-28 ms 1:1	$3295	$3495	$3695
	80 MB-28 ms 1:1	$3595	$3795	$3995
	157 MB-17 ms ESOI	$4095	$4295	$4195
386/33	40 MB-28 ms 1:1	$4195	$4695	$4895
	80 MB-28 ms 1:1	$4795	$4995	$5195
	157 MB-17 ms 1:1	$5195	$5395	$5595

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How a 14th century swordmaker helps Everex build cutting-edge computers.

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Letters

POOR ASSESSMENT

I would like to congratulate you on Alfred Poor's analysis of PostScript add-in boards ("Add-in Boards for the HP LaserJet: Post-Purchase PostScript," *PC Magazine*, April 11, 1989). Having personally evaluated many of the reviewed products in search of an "ideal solution," I am in full agreement with his conclusions.

While I commend Mr. Poor's thoroughness, I am a bit surprised that he failed to mention that Princeton Publishing Labs' PS-388 Accelerator (the Editor's Choice) is manufactured by Raster Image Processing Systems. I use one of these phenomenal boards every day, and there's no way I'd ever part with it.

Ron LaFon
Sonoma, California

Fast is nice, but why no mention ot 400-dot-per-inch output in your article "Add-in Boards for the HP LaserJet: Post-Purchase PostScript"?

I recently made an abortive attempt to use EiconScript, which came bundled with a CX-engine laser printer. My main reason for attempting to use the laser printer/Eicon solution was the promised 400-dpi output. The 400-dpi print samples were excellent--a great improvement over 300 dpi. But why didn't your article address this factor?

Ann Ivins
New York, New York

THE RIGHT CHECK WRITER

I was disappointed by Gus Venditto's review of *Andrew Tobias' Checkwrite Plus* (After Hours, *PC Magazine*, April 11, 1989), particularly in light of the many good things *PC Magazine* has said in the past about *Andrew Tobias' Managing Your Money*, its parent program.

There is no question that, as Venditto found, it's much quicker to get into *Quicken* than it is to get into *Checkwrite Plus*. This is a fair criticism, and it has led us to consider a more structured setup procedure for the next release.

ADD-IN BOARDS FOR THE HP LASERJET

Post-Purchase PostScript

P.S. Too late tor PostScript?

But it's a shame Venditto stopped there. His assessment would ring true only if *Quicken* and *Checkwrite Plus* were to be used once and then discarded. We had the same problem with *Managing Your Money* the tirst tew years. Yes, you'll spend 2 or 3 hours getting a good start with *Checkwrite Plus*. But if your aim is to use the program to run your small business (or your own finances) for the next few years, is that really ot that much concern?

Some of the things *Checkwrite Plus* gives you that we think justify the extra setup time are the ability to edit the check format to suit just about any style check, real budgeting (versus *Quicken*'s work-around scheme with check memos), and automatic loan processing and record keeping.

Venditto is right: *Quicken* is a good, simple program. It all that matters is a tast start, then it is unquestionably the right choice—just as it's faster to get going with a new typewriter than with a new word processor.

Andrew Tobias
Miami, Florida

SUBSCRIPTION BLUES

I look upon *PC Magazine* as the standard by which all others are judged. Yet I can't understand why, when I recently subscribed under the free utilities disk offer, it took 126 days to get the disk. And if that wasn't bad enough, 99 percent of the programs were so old that I had to clean the dust and cobwebs out of the disk. I don't mean to be crude, but how about offering something more up-to-date in software?

One more thing—can I get a cardboard-free subscription if I pay more?

Richard H. Flathann III
Mount Vision, New York

While I am a satisfied *PC Magazine* subscriber at the moment, I cannot understand why the great utilities that you offer for new subscribers are still unavailable on 3½-inch disks. I have no way to transfer them from 5¼-inch disks and can't afford the time to download them all off of PC MagNet.

Mark Adkinson
Oklahoma City, Oklahoma

AND THE ENVELOPE—PLEASE!

In last year's printer issue, you selected the NEC Pinwriter 5200 as an Editor's Choice ("Dot Matrix Printers: The Market Matures," *PC Magazine*, October 31, 1988). It worked nicely until I tried to print an envelope. Even after adjusting the thickness lever, the printer still smeared the envelope.

I called NEC's technical support number, and the company's response was that the 5200 was not designed to print envelopes! How can you recommend a printer that will not print an envelope to go with the letter it types?

I suggest that you begin testing printers to see if they will print envelopes before you make them Editor's Choices. After all, how do you think this letter was sent to you?

Robert G. Floyd
Lexicon, North Carolina

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Letters

TANDY'S DANDY POLICY

Probably no computer manufacturer/retailer has had more hot coals piled on its head than Tandy Corp. Some of the criticism is justified (for example, the Models 2, 4, 12, 600, and 1200), but much of it is due to a lack of understanding.

Tandy was one of the first, if not the first, to put a complete package on the market (one that worked when it was plugged in) and into the hands of the public. By putting ROM BASIC into the public's hands, Tandy gave the beginner instant gratification.

At the very least, Tandy deserves praise for one company policy that has not received much acclaim: its refund policy. I bought a DWP-230 printer last week, and yesterday a sales flier came offering a $160 price reduction on the same printer. I went back this afternoon, sales slip in hand, and was issued a refund of the difference—including tax and courtesy.

It's all right to give Tandy the devil, but at least give the devil his due!

Walt Stevenson
Pittsburgh, Kansas

HOW SWEDE IT IS

This is really tremendous! Sitting here in front of my PC, I am only a local call away from a wealth of information—a bank of useful programs that I can search at will.

I am calling PC MagNet and CompuServe via the Swedish packet-switching network, DATAPAK. It works like a dream—no breaks or retransmissions during file transfers.

Now is when all the fun begins.

Tommy Wirestram
Solna, Sweden

A GLOBAL PERSPECTIVE

Today, over 55 percent of Microsoft's revenue comes from outside the U.S. market. Why doesn't *PC Magazine* cover computer trends outside of the United States? There are *PC* readers all over the world, and I bet American readers would love to know what's going on in other countries. American software developers, as well, will better understand markets abroad. How about making *PC Magazine* more global?

Niklas Mollberg
Kirkland, Washington

PRE-DVORAK COMPUTING

In a recent issue, John C. Dvorak writes: "Since when does DEC set trends? It hasn't set one since it invented the minicomputer decades ago" (Inside Track, *PC Magazine*, April 11, 1989). Now, DEC and Ken Olsen may have done many things, but inventing the minicomputer wasn't one of them. The first minicomputer, the Elecom 100, was invented by Dr. Samuel Lubkin and built by his Electronic Computer Corp. around 1952. It was also the first computer to use a tape drive.

Today, over 55 percent of Microsoft's revenue comes from outside the U.S. market. Why doesn't *PC Magazine* cover computer trends outside of the United States for readers all over the world?

Lubkin was quite well known in the days before John Dvorak was weaned. Lubkin was the first person in charge of the ENIAC. He designed the logic of both the EDVAC and SEAC, invented dynamic (clocked) logic, and had over 100 computer patents issued. Everybody paid Lubkin royalties, and his lawyer—not Lubkin—got rich.

Yale Jay Lubkin
Owings, Maryland

SEEING ABOVE THE CONFUSION

I would like to clarify one point made in the review of our product *Turbo EMS* (First Looks, *PC Magazine*, February 14, 1989). The article implies that Tele-Ware Corp. is still marketing a product called *Above DISC*. We are not. As your reviewer pointed out, we developed the original *Above DISC* software and contracted with a marketing firm to publish it for us. When we elected to seek a new

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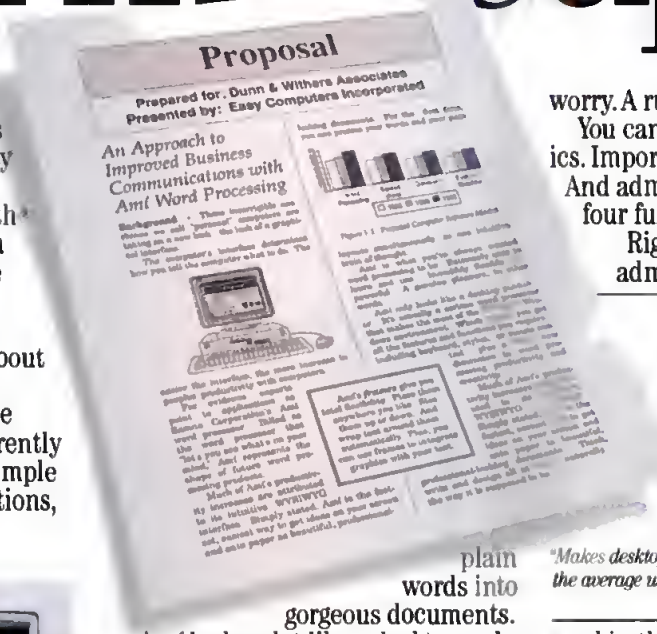

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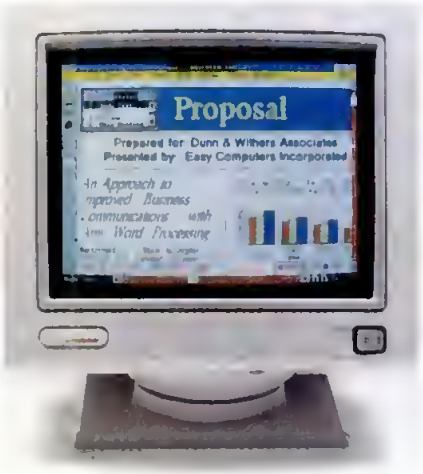

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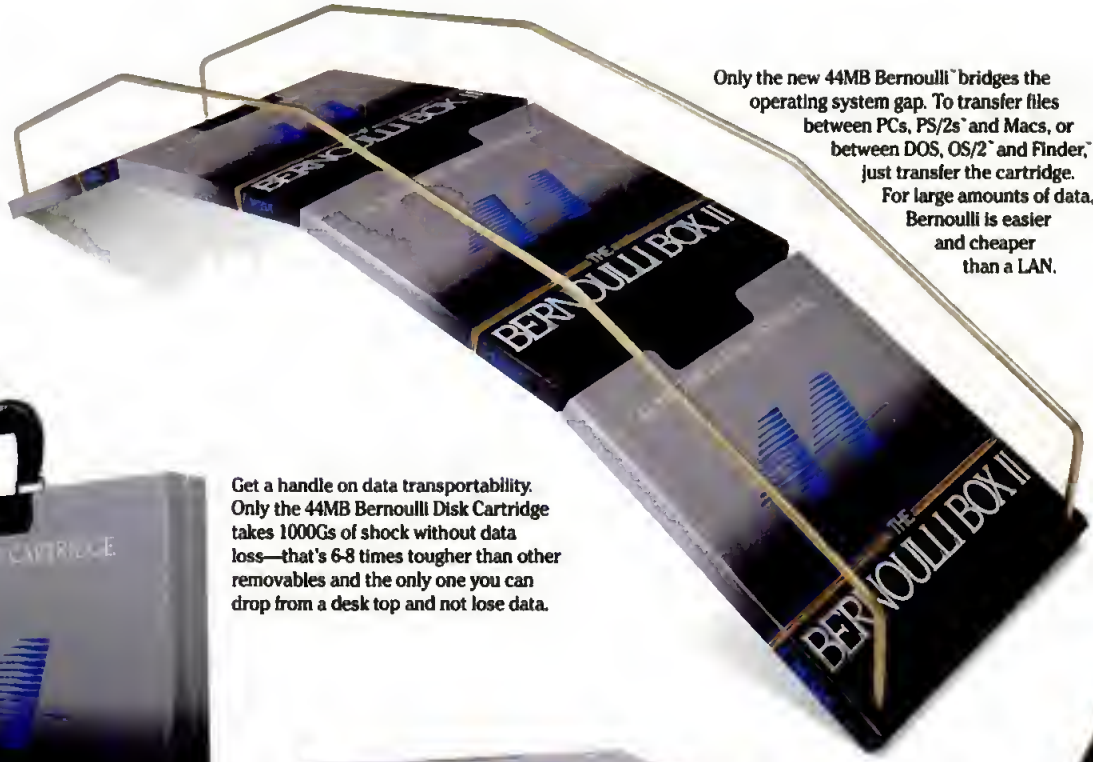

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PC MAGAZINE EDITOR'S CHOICE

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Letters

publisher for our product, the trademark "*Above DISC*" stayed with our ex-publisher.

Therefore, our software was marketed as *Above DISC,* Versions 1.0 through 1.3, only. Subsequent releases have all been under the *Turbo EMS* label. We have no connection whatsoever with any other versions of or upgrades to any software currently being marketed under the "*Above DISC*" trademark.

I bring this to your attention not to criticize your review, but to provide you with information that I hope will prove useful should you get inquiries regarding "our" upgrades.

Karen Lund
President
Tele-Ware Corp.
Pittsford, New York

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OS/2 BE OR NOT TO BE

If IBM and Microsoft want to see OS/2 running on more computers, they will have to take a long, hard look at what they are shipping.

Regardless of OS/2's possible merits, the real problem is installing the software. The automated INSTALL program does not work, and my local dealer was unable to provide any assistance. I had to repeatedly call the dealer, who called IBM; IBM then called back the dealer, who called me. After wasting literally days within this vicious circle, I finally gave up and asked for my money back.

OS/2 might be the best operating system ever, but it is crippled by a complicated installation process and a lack of support.

Jay Munro
Stamford, Connecticut

The main objective of any business is to turn a buck. Microsoft, Intel, and IBM are not around for the sole purpose of pleasing the masses; they are out to make money. This does not mean that OS/2 or state-of-the-art hardware is being shoved down our throats.

OS/2 was designed to take advantage of the technology we have been unable to utilize since 1984. It has been long awaited, and I'm glad it's here. Far from just a means to implement the power of existing hardware, OS/2's design will provide the foundation for withstanding future hardware advancements as well as present a clearer direction for software development.

Craig Hubbs
Knoxville, Tennessee

WHAT DOES PC STAND FOR?

With all due respect, John C. Dvorak's "The Death of Progress" (Viewpoints, *PC Magazine*, May 16, 1989) has it backwards—the term "PC" originally meant "personal computer." That is, it referred to a computer small enough and cheap enough for individuals to afford. Mr. Dvorak contends that those of us with older equipment should scrap our investments for the benefit of the technological elite. Those who like to spend their money on the latest fads are welcome to do so. But I'd like to remind Mr. Dvorak who made the personal computer industry a success in the first place.

David C. Hay
Edison, New Jersey

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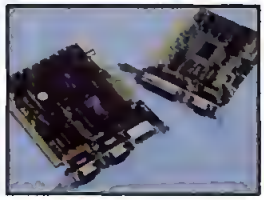

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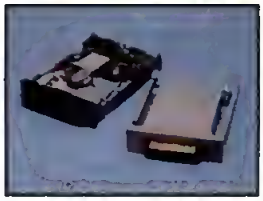

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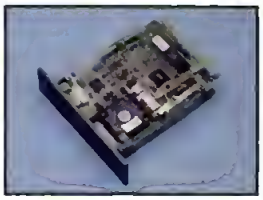

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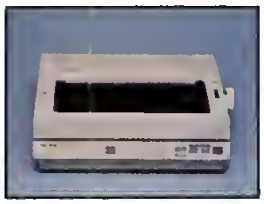

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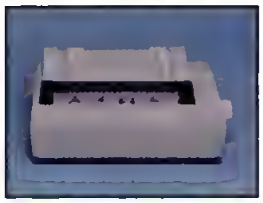

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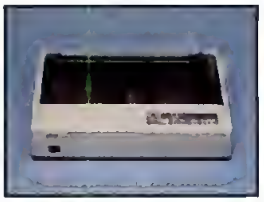

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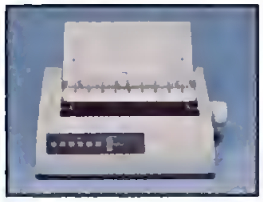

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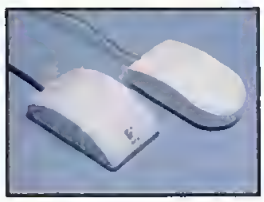
P341SL (216cps, 132 col, 24-pin) $659
P351SX (360cps, 132 col, 24-pin)$Call

MICE



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NEW Serial Mouse (320 dpi) $79
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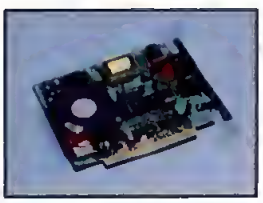
MODEMS



ATI

2400 etc internal $159

Hayes Smart Modem

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1200 bd External $289
2400 bd Internal ..... $Call

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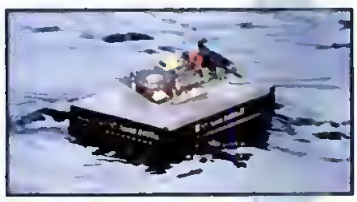

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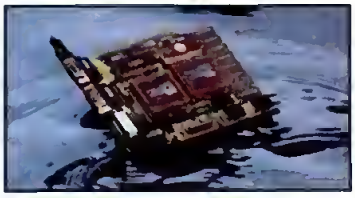

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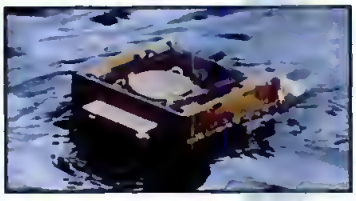

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by Lori Grunin

Advisor

ANOTHER EYESAVER

Your recommendation of SkiSoft Publishing's *No-Squint Laptop Cursor* to cure a faint cursor on an LCD screen was a good one (PC Advisor, *PC Magazine,* April 11, 1989), but there is an alternative that laptop owners should be aware of: *NoBlink/Accelerator* by Nostradamus Inc. ($49.95; 3191 Valley St., #252, Salt Lake City, UT 84109; (801) 487-9662). *NoBlink* was one of *PC Magazine*'s favorite utilities in 1987.

Neither *No-Squint* nor *NoBlink* works perfectly with all software. I lean toward *NoBlink* because it works better with Microsoft's CodeView, while one of my colleagues prefers *No-Squint* because it behaves well with the *Number Cruncher* statistical system.

Gerard Dallal
Malden, Massachusetts

ONE-FINGER TYPING

I am trying to locate two pieces of software that should make working with an IBM-compatible computer easier for a person who has the use of only one hand.

The first is a utility that allows key combinations, such as Ctrl-F8, to be pressed in sequence rather than together. The second package is a commercial package called *PRD+*.

Elizabeth Swoope Johnston
Baton Rouge, Louisiana

As you probably know, *Productivity Plus*—also known as *PRD+*—is a customizable TSR that expands abbreviations as you type them. For example, when you type "asap," *PRD+* automatically expands it to "as soon as possible." The program, available directly from Productivity Software International (1220 Broadway, New York, NY 10001; (212) 967-8666) comes in two editions: a 4,000-abbreviation Standard Version for $89.95 and an 8,000-abbreviation Professional Version for $129.95.

What you might not know is that the company also includes on the *PRD+* disk a program called *Peck*, which allows you to enter keystrokes sequentially. *Peck* does not require *PRD+* to run — the company also sells it individually for $9.95. Thankfully, the program uses less than 1K of memory, since you can't unload it from memory without rebooting your system.

Two other programs, both of which use less than 1K of RAM, give you the ability to hit keys sequentially. STAYDOWN.COM, a utility available on PC MagNet (see the "By Modem" sidebar in the Utilities column for access information), can be unloaded from the command line. It works only for two-keystroke sequences, however, so you're stuck when it comes to soft reboots.

A shareware product called *KeyLock* can handle three-keystroke sequences, but it works only with genuine Big Blue BIOSs and can't be unloaded from memory without rebooting. You can get it directly from PC-SIG ($6, plus $4 shipping and handling; 1030 E. Duane, Suite D, Sunnyvale, CA 94086; (408) 730-9291) or from the PC-SIG Library CD-ROM.

- ANOTHER EYESAVER: Curing the laptop cursor squints.
- ONE-FINGER TYPING: Entering combination keystrokes sequentially.
- COMPUTERSPEAK: Digitizing sounds with your PC.
- OUTPUT ON THE ROAD: Lightweight printing with your laptop.
- WORDS ON-DISK: Finding an on-line dictionary.

COMPUTERSPEAK

With regard to your discussion on Speech Thing in the February 28, 1989, PC Advisor column, there is a product sold by Forte ($249; 72 Karenlee, Rochester, NY 14618; (716) 427-8595) called the Audio F/X card that also allows digital recording and playback. Additionally, this vendor's card comes bundled with music creation/playback software and an easy-to-use sound-effects-generation package.

The length of recorded information is limited only by available disk space. Once digitized, the waveforms can be edited, amplified, filtered, time-shifted and added (producing echo), and combined with other prerecorded data.

Mike McCourt
Rochester, New York

OUTPUT ON THE ROAD

A while ago I bought a luggable computer and a smallish dot-matrix printer as backups for my desktop units and to carry with me on trips. I recently replaced the computer with a laptop, and I'd like to replace the printer with something a bit less weighty.

Jim Held
Del Mar, California

Of the truly portable printers available, perhaps the best one to consider is the Diconix 150 Plus, the latest incarnation of the Diconix 150 ($499 with parallel interface, $519 with serial interface; Diconix Inc., 3100 Research Blvd., P.O. Box 3100, Dayton, OH 45420; (513) 259-3100).

This ink jet printer is good for the road because it's small and quiet: it weighs between 3 and 4 pounds, with a footprint of 2 by 6½ by 11 inches (HWD), and emits noise at only 45 decibels. It operates off C-size rechargeable batteries and emulates the IBM Proprinter and Quietwriter and the Epson FX85/100 printers.

Of course, the printer probably won't compare favorably with whatever on your desk. It's relatively slow—rated at up to only 180 characters per second in draft

mode—and you probably wouldn't want to print your resume on it. You'll also replace ink cartridges more than you'd like, at between $10 and $15 a pop.

If you'd rather stick with impact dot matrix technology, Axonix offers the 6.5-pound ThinWrite 100, a 9-pin printer with a relatively compact 2.75- by 12- by 8-inch footprint ($499; 2257 South 1100 East, Salt Lake City, UT 84106; (801) 466-9797) that operates off either AC or battery power. Print quality isn't that of a desktop printer, but it's readable.

WORDS ON-DISK

Where can I get a dictionary on floppy disks in ASCII format?

Richard Cory
Brooklyn, New York

Now that you're ready to abandon your trusty desktop dictionary in favor of a smaller electronic one, you have several choices.

If you want a small dictionary to pop up over your applications, then you should opt for Proximity Technology's *Choice Words* ($99; 3511 NE 22nd Ave., Fort Lauderdale, FL 33308; (305) 566-3511), an 80,000-word dictionary and 470,000-synonym thesaurus, compliments of Merriam-Webster. The dictionary provides entries broken down by part of speech but doesn't offer pronunciations, and the definitions are more terse—two lines long at the most—than concise.

Choice Words eats up only 1.6MB of disk space and 100K of RAM, as opposed to the 5MB and 128K taken up by *Funk & Wagnall's Standard Desk Dictionary* from Inductel ($79.95; 18661 McCoy Ave., Saratoga, CA 95070; (800) 367-4497, (408) 866-8016). Inductel's offering gives you 100,000 entries and longer definitions, including facts about states and cities around the world, biographical information, a list of common acronyms and abbreviations, and a usage handbook.

The package can also be integrated with other reference works in the company's Knowledge Acquisition System, which consists of such titles as *The Dictionary of Computer Terms* and *The Dictionary of 26 Languages in Simultaneous Translation*.

For the serious word cruncher, neither product is much more than a glorified spelling checker—the lexicons are too limited. If words are your life and you're ready for the CD-ROM plunge, you might consider the $295 *Microsoft Bookshelf* (Microsoft Corp., 16011 NE 36th Way, Redmond, WA 98073; (206) 882-8080), which counts among its reference works *The American Heritage Dictionary*.

For a steeper investment of $950, Tri-Star Publishing puts all 12 volumes of the *OED* at your fingertips with *The Original Oxford English Dictionary on Compact Disk* (475 Virginia, Fort Washington, PA 19034; (800) 872-2828). Reviews of both CD-ROM products appear in "Archives in Miniature," in the January 31, 1989, issue of *PC Magazine*.

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). Please specify your equipment. ■

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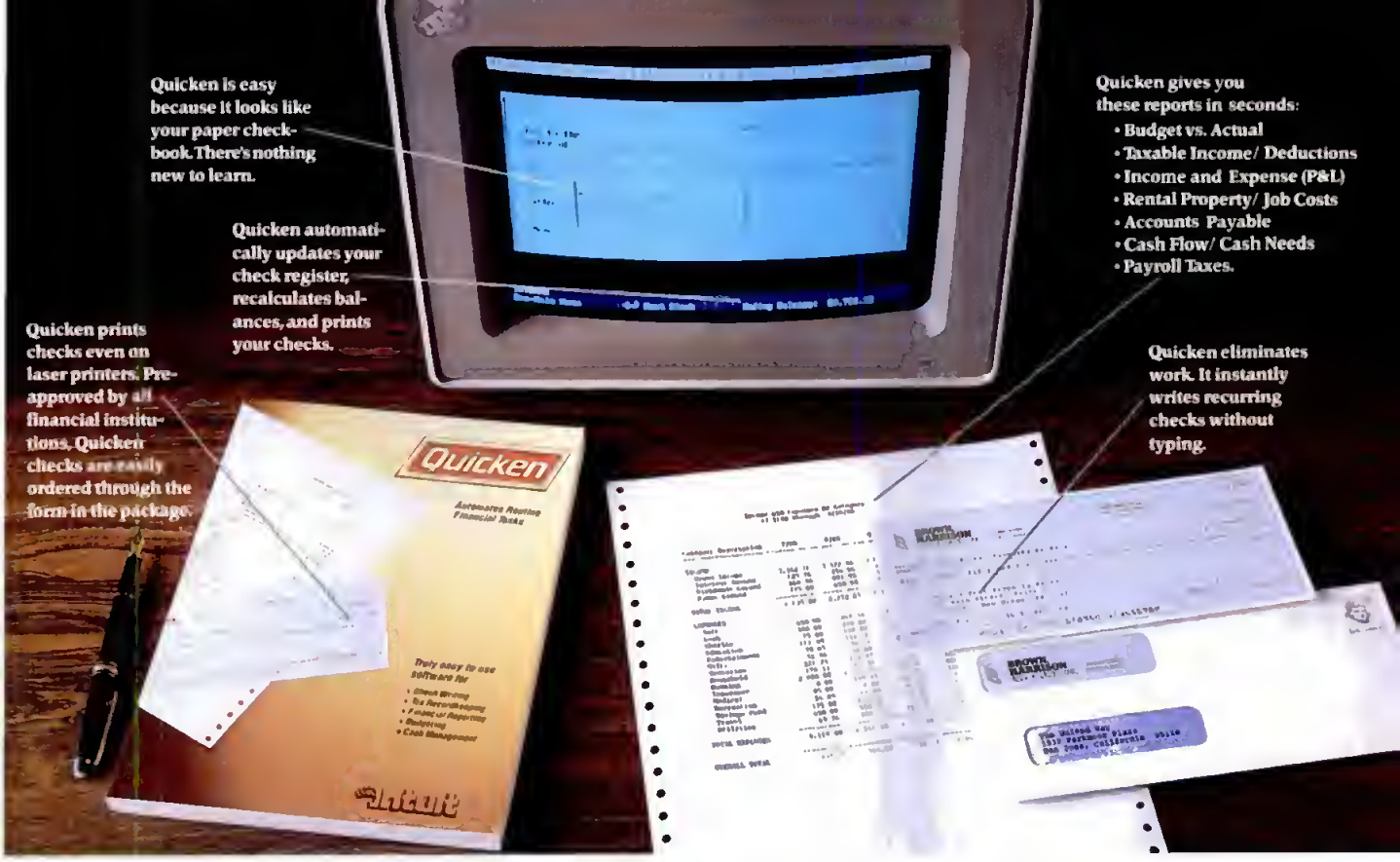

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Paul B. Ross, January 17, 1989
PC MAGAZINE Best of 1988 AWARD
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Bill Howard, Executive Editor
PC Magazine, December 27, 1988

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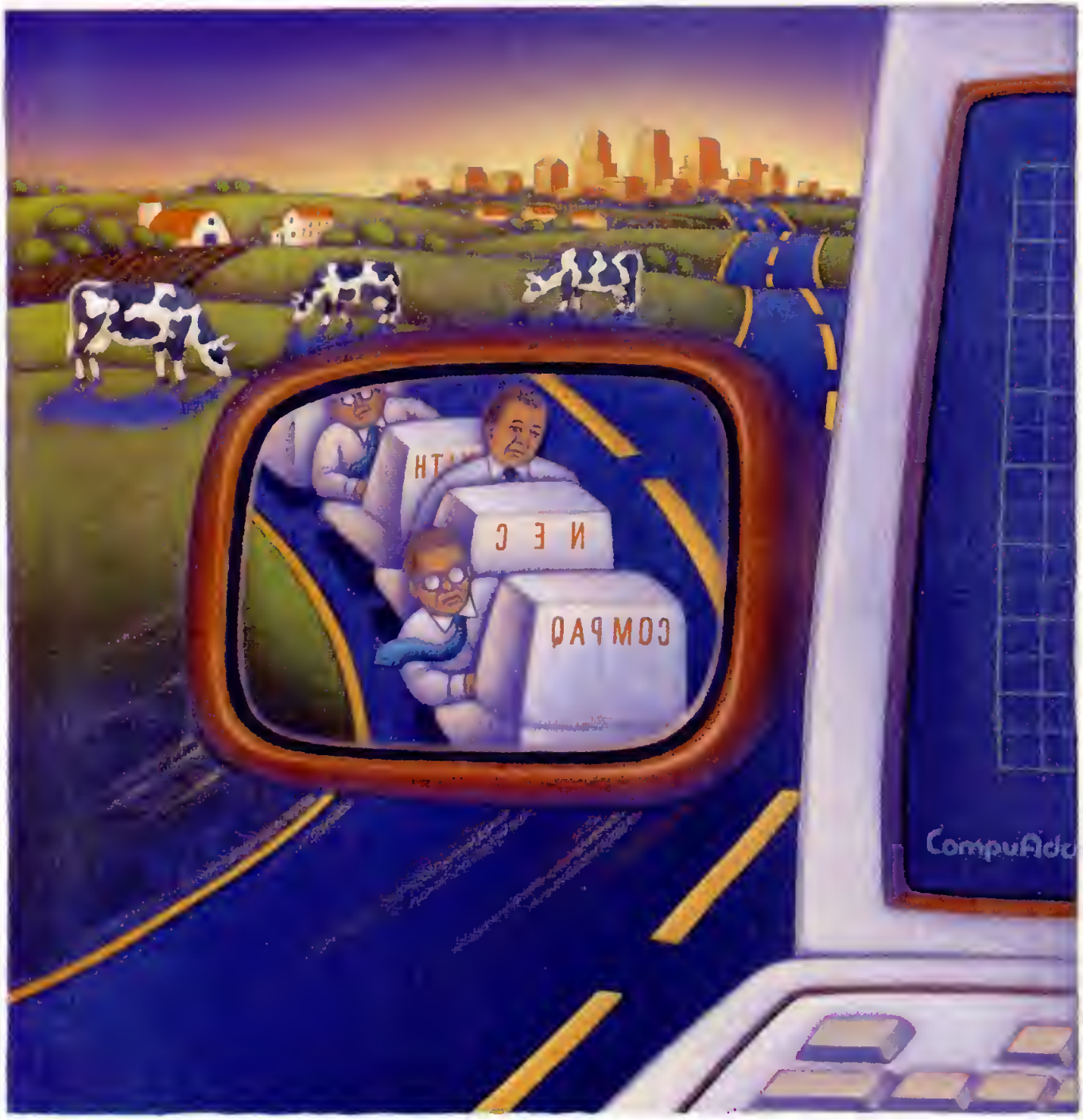

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PC Magazine (4-11-89)

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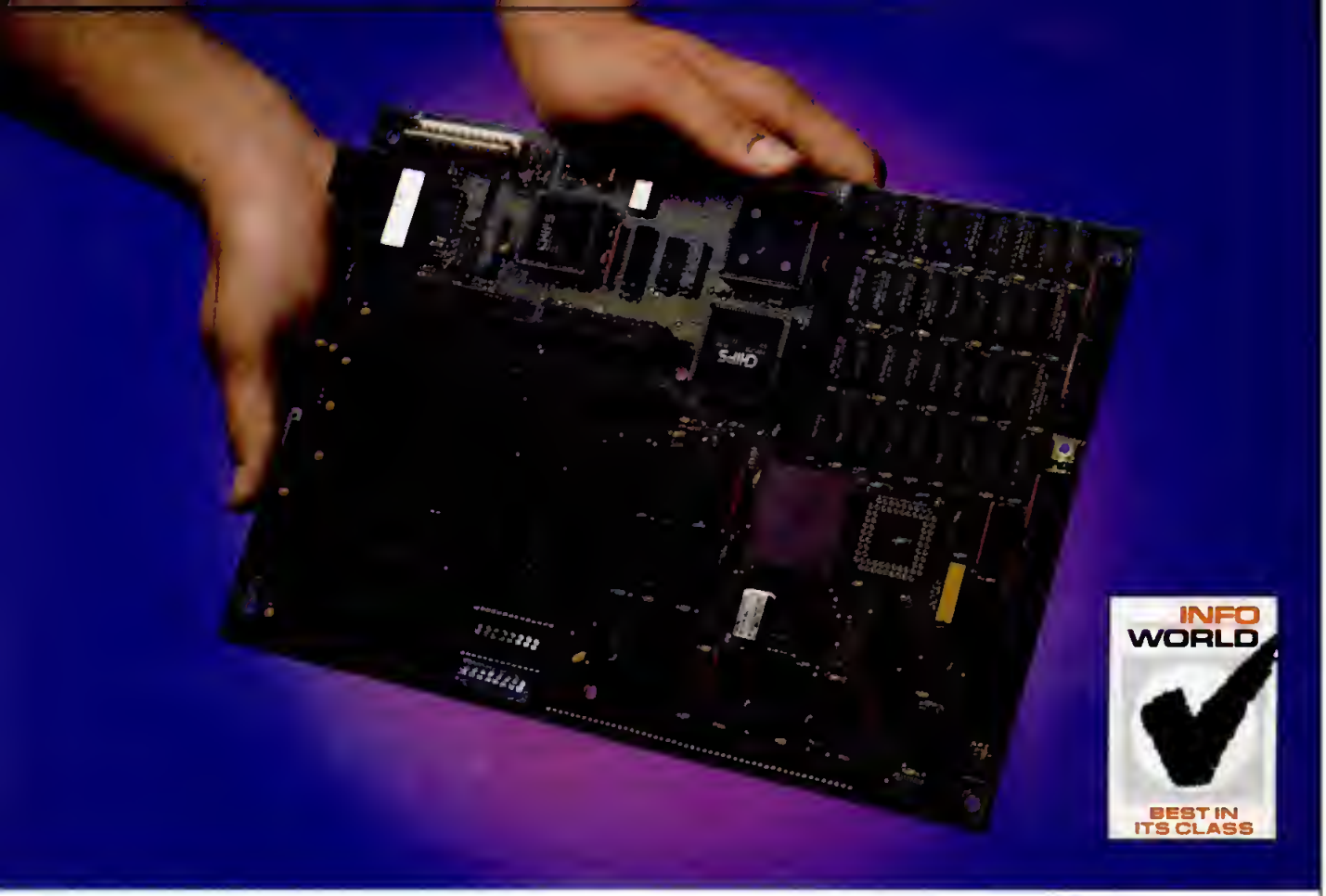

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CIRCLE 276 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

IBM Introduces Feature-laden Portable PS/2 Model P70 386, Entry-Level PS/2 Model 55 SX

HANDS ON
by Mitt Jones

IBM's latest PS/2 introductions prove that IBM can still do it right when it wants to. Unfortunately, they also remind us that it doesn't always want to.

The star performer of the two new models—the lunch-box-style IBM PS/2 Model P70 386—boasts a features set straight out of a *PC Magazine* portable-computer wish list. About the only thing IBM left out of this $7,695 portable is a self-propelled cart to help you lug all this power about.

The lesser of the two offerings, the $3,895 IBM PS/2 Model 55 SX, puts Intel's 16-MHz 386SX in a Model 30 chassis for a decidedly entry-level look. As if to ensure its status as an entry-level machine, IBM also endowed the 55 SX with a hard disk you'd probably find barely acceptable in an 8-MHz AT.

Geared toward distinctly different buyers, these machines share little common ground but their Micro Channel architecture and a generous endowment of standard-equipment RAM—4MB for the P70 and 2MB for the 55 SX. Announced along with a battery of hardware and software rebates for buyers of IBM OS/2, the move is meant to encourage users to begin the move away from DOS.

IBM's PS/2 Model 55 SX (left) and Model P70 386 share little but their Micro Channel architecture.

IBM PS/2 MODEL P70 386

Especially in light of IBM's dubious history of DOS-to-go offerings, the PS/2 Model P70 comes as a pleasant surprise. Though not the fastest 20-MHz portable around, the AC-powered P70 holds its own against most of the competition, including the popular 20-MHz Compaq Portable 386.

Even the hard disk, a component IBM often seems content to botch, comes geared for performance. The standard-configuration 60MB drive

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Microsoft QuickPascal 1.0 Challenges Turbo Pascal 5.5

HANDS ON
by Neil J. Rubenking

The status of Pascal as a serious development language and the importance of object-oriented programming (OOP) as a methodology have been strengthened with the introduction of Microsoft Corp.'s QuickPascal 1.0 and the upgrade to Version 5.5 of Borland International's Turbo Pascal.

QuickPascal, which at the time of this writing was in its final beta release, is almost completely compatible with Turbo Pascal 5.0. Like Turbo Pascal 5.5, it has object-oriented extensions. Both Turbo Pascal and QuickPascal are based on Apple Computer's Object Pascal. Whereas QuickPascal strictly follows the Object Pascal specification, Turbo Pascal makes use of C++ concepts as well. (C++ is an object-oriented extension of the C language.) The two Pascal implementations are similar, but there are enough differences that it's difficult for a programmer to write code that

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PHOTOGRAPH: THOM O'CONNOR

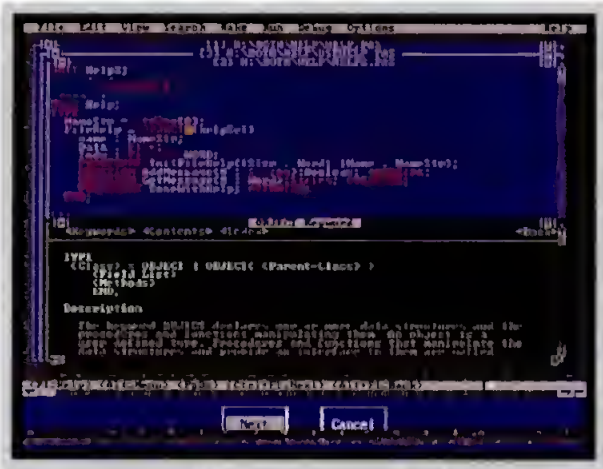
TURBO PASCAL

CONTINUED FROM PAGE 33

will compile under both.

QuickPascal's objects are dynamic, and their methods are virtual; like pointer variables, they must be initialized with "New." Objects in Turbo Pascal 5.5 are dynamic only if you declare them as such, and methods don't have to be virtual. The bottom line: QuickPascal gives you consistency; Turbo Pascal, flexibility.

As part of its apparently wholehearted embracing of OOP concepts, Borland packages Turbo Pascal 5.5 with a lengthy "Object Oriented Programming Guide" that thoroughly explains the topic and is all you'll need to begin working with objects. QuickPascal, on the other hand, devotes a scant dozen pages of its manual to explaining object-oriented techniques. Count on doing some additional reading before using QuickPascal's object-oriented programming features.



This QuickPascal session has three open editor windows. A help window shows data on the OBJECT keyword.

QuickPascal's mouse-intensive interface, familiar to users of other Quick languages, will be the envy of Turbo programmers. It lets you open up to nine editor windows on the same file or different files and move, resize, tile, and close them. If you don't like the editor's keystroke combinations, you can choose to have the program emulate one of several popular text editors.

Programmers will find QuickPascal's color-coding scheme helpful for spotting errors: comments appear in one color, Pascal identifiers in another, and literal strings in a third. For example, if you type in PROCEDRUE for PROCEDURE, you'll notice right away that your text *doesn't* assume the identifier color. If you forget to close a comment, that too will result in an inappropriate color for your code. Other useful QuickPascal features include a tutorial program; a hypertext-like help system, which allows you to cut out the examples and paste them into your programs; and the ability to generate 80286 opcodes.

Instead of using the proprietary Borland Graphics Interface (BGI), QuickPascal uses its own MSgraph Unit. Unlike the BGI, MSgraph supports 256 color modes on VGA and MCGA systems. Other than this difference and the program's lack of an overlay manager, QuickPascal is compatible with Turbo Pascal, even to a fault. Like Turbo Pascal, it will not produce OBJ files, so it's no better than its rival for mixed-language programming. (An OBJ file is an intermediate step in compiling a program.)

OOP is the main novelty in Turbo Pascal 5.5, but the program features other enhancements as well. As with previous revisions, the compiler is a little faster. Like QuickPascal, the program has a tutorial and a help system, which allow you to cut and paste examples. Both the integrated debugger and the standalone Turbo Debugger support objects. In the Turbo Debugger, you can bring up a window that displays the object hierarchy of the program. The Inspect window lets you peek into either an object type or a particular instance of that type. And in the Evaluate window you can actually call an object's methods.

Turbo Pascal's overlay manager got smarter. Predefined variables let the programmer monitor overlay action, and a new algorithm helps keep often-used code in memory. Programmers can control the overlay file's access mode for use on networks or append the overlay

FACT FILE

Turbo Pascal 5.5
Borland International, 1800 Green Hills Rd., Scotts Valley, CA 95060; (408) 438-8400.
List Price: $149.95; Turbo Pascal Professional 5.5 (includes Turbo Debugger with object-oriented enhancements and Turbo Assembler), $250.
Requires: 256K RAM for command-line compiler, 448K RAM for integrated development environment (640K RAM recommended); DOS 2.0 or later (hard disk recommended).
In Short: This upgrade adds object-oriented extensions to the Turbo Pascal compiler and to its standalone debugger. Smart-linking extends to object methods, so unused methods take no code space.

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QuickPascal 1.0
Microsoft Corp., 16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717; (206) 882-8080.
List Price: $99
Requires: 448K RAM (512K RAM recommended), DOS 2.1 or later
In Short: Microsoft's impressive entry into the Pascal world combines an enhanced "QUICK environment" with Turbo Pascal 5.0 compatibility, and it goes beyond Turbo Pascal 5.0 with object-oriented programming.

CIRCLE 459 ON READER SERVICE CARD

The ABCs of OOP

by Neil J. Rubenking

Object-oriented programming (OOP) is an extension of structured programming, the basis of Pascal. It adds still more structure by binding data together with the routines that act on it. Object-oriented code is also highly modular, so it's easy to replace or enhance parts of a program without affecting the rest of it.

An object in object-oriented Pascal has data fields like a record, but it also includes methods (procedures and functions) that act on the data fields. Bundling code and data together like this is *encapsulation*.

One object can be declared as a descendant of another. The descendant automatically inherits all of the data fields and methods of its ancestor. The descendant's definition contains only new fields, new methods, and methods that override the ancestor's methods. A method that can be overridden is a *virtual method*.

When you declare a descendant object type, you're extending the ancestor. The descendant is everything the ancestor was and more. This extensibility means that you can build on your existing object-oriented code without ever having to completely rewrite it.

Type-compatibility requirements are relaxed slightly for objects. There are situations in object-oriented Pascal in which a variable's actual type may be any ancestor of the declared type. As a result, you can write procedures that deal with objects whose type is not known until runtime. Such an object is called *polymorphic*.

Encapsulation, inheritance, extensibility, and polymorphism—these are the main concepts of OOP. Grasp them and you're ready to start writing modular, reusable code.

Turbo Pascal

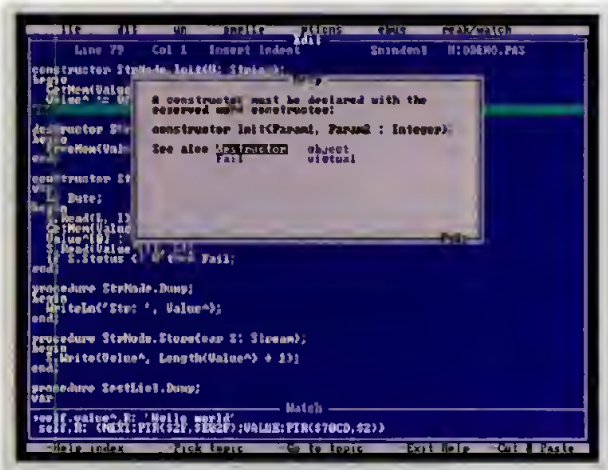
CONTINUED FROM PAGE 34

to the end of an .EXE file for a one-file program.

Turbo Pascal 5.5 retains the smart-linking capability of Version 5.0 and extends it to cover *methods*. Turbo Pascal programmers can now give objects any methods they might need; the smart linker will strip out any that are never called. QuickPascal's smart-linking doesn't extend to methods. Initializing a single QuickPascal object variable bloats your code with all the methods of that type *and* its ancestors. An informal test program with a 100-level object hierarchy produced a 4K file under Turbo Pascal but nearly 10K under QuickPascal.

When Borland entered the Pascal race, its $50 compiler cost a tenth of the going rate for such a product. Now Turbo Pascal costs $149.95, about $50 more than Microsoft's QuickPascal. (Turbo Pascal with Turbo Debugger and Turbo Assembler costs $250.) The low price of QuickPascal and the attractiveness of its environment should make the program appealing to students, a market that has traditionally belonged to Borland. On the other hand, because the QuickPascal environment is so big, you'll have to *leave* it to compile large programs. In that case, the Turbo Pascal command-line compiler, with its smart-linking feature, becomes a more attractive option.

But whichever implementation of Pascal you choose, one thing is clear: a healthy competition between Microsoft and Borland will mean more enhancements for users. ■



in this Turbo Pascal 5.5 session, the user is single-stepping through an object's CONSTRUCTOR method.

IBM MACHINES

CONTINUED FROM PAGE 33

sports an integrated ESDI controller and shows an average random access time of 23 milliseconds on the PC Labs benchmark tests. The disk subsystem doesn't perform as well as one might expect on the PC Labs DOS File Access tests, given its 8.4-megabit-per-second rating, but it performs well nonetheless. It also runs mercifully quietly. IBM offers a 120MB version rated at 10.2Mb per second at an additional cost of $600.

The P70's 16-shade VGA display, which measures slightly more than 10 inches diagonally, undoubtedly ranks among the most impressive of the gas-plasma variety we've seen so far. In text modes, the orange characters are bright and well formed, and the black background seems genuinely black.

It is in graphics mode that this display truly excels, however. Running the VGA paint program *Colorix* side by side with the Toshiba T5200, the P70 showed an uncanny ability to translate 256-shade graphics into smooth, attractive monographics screens.

The IBM display isn't perfect: when displaying other *Colorix* files, the P70 sometimes converted too much of the screen to black. In one case, and an ironic one at that, the simulated shadow of an IBM logo was completely lost when the P70 translated both the shadow and the background color to black. The Toshiba screen didn't look as smooth, but it did retain the shadows. Also, vertical picture size varies significantly on the IBM among different graphics modes.

The display allows a fair amount of position adjustment, pulling away from the box slightly and pivoting from the top through an angle of about 30 degrees. To the right, a 1.44MB floppy disk drive pivots out from the chassis. The power switch and disk access indicators lie in plain view below the floppy disk drive.

Another eye-catcher is a full-size 101-style keyboard, which latches nicely over the front side of the box. IBM trimmed a bit of useless plastic off both ends, but the keyboard layout and spacing perfectly match those of an IBM desktop keyboard. Alas, the keys themselves, equipped with membrane-type actuators rather than IBM's usual spring type, lack that solid IBM click, but the feel is still better than you'll find on most clones.

The P70 comes standard with an impressive collection of ports: 25-pin serial and parallel ports; an IBM mouse port; a squarish, proprietary connector for IBM's external floppy disk drive; and an analog video port that drives an external color VGA monitor. All are easily accessible on the back of the box through either a large hinged door or a smaller sliding door. Also in the back of the box, to the left of the ports, you'll find the end openings for the two MCA slots.

To get to the slots themselves, you unscrew three screws on the back panel and lift off the entire panel. Once inside, you can install a full-length card in the 32-bit top slot or a half-length card in the 16-bit slot below.

To the left of the slots, the 80387 math coprocessor socket and four snap-in SIMM connectors lie in plain view and within easy reach. Two of the connectors come occupied with 2MB of 85-nanosecond SIMMs (our evaluation unit came with 80-ns. memory). You can install either 1- or 2MB SIMMs in both remaining connectors for a generous motherboard maximum of 8MB.

Of course, all this power doesn't do you much good if you can't carry the machine, and the P70 suffers from the same weight limitations as its competition. IBM outfitted the machine with a rubber handle grip to make carrying the machine a little less painful, but its total of 20.8 pounds—without expansion cards—still becomes a burden quickly enough.

Surprisingly, however, the size of the machine, as opposed to its weight, wasn't a problem: though measuring 18.25 inches in width, necessary to accom-

CONTINUED ON PAGE 36

FACT FILE

IBM PS/2 Model P70 386
IBM Corp., contact your local authorized IBM dealer.
List Price: With 60MB hard disk, $7,695; with 120MB hard disk, $8,295; optional carrying case, $350 (leather) or $180 (nylon); IBM PS/2 Internal Modem/A, $449.
In Short: A feature-packed 20-MHz lunchbox portable with two MCA slots, 4MB RAM, a full-sized 101-style keyboard, and an impressive 16-shade VGA gas-plasma display.

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IBM PS/2 Model 55 SX
IBM Corp., contact your local authorized IBM dealer.
List Price: With 30MB hard disk, $3,895; with 60MB hard disk, $4,295; 80387SX math coprocessor, $795.
In Short: A 386SX-based machine with entry-level limitations at a midlevel price.

CIRCLE 457 ON READER SERVICE CARD

IBM MACHINES

CONTINUED FROM PAGE 35

modate the full-sized keyboard, the machine measures only 12 inches high and 5 inches deep. The narrowness of the machine keeps it from knocking into your body like some other machines.

IBM PS/2 MODEL 55 SX

IBM shows no signs of discontinuing its 286 machines just yet, but the PS/2 Model 55 SX certainly seems designed, if not priced, as an entry-level system.

If the case looks familiar, it should. It's the same box, perhaps with minor modifications, that adorns the 8086-based Model 30 and 286-based Model 30 286. While it looks rather nice and measures only 4 inches high, 16 inches wide, and 15.75 inches deep, the case also carries serious liabilities, most notably its accommodation of only two disk drives: a 1.44MB floppy disk drive and either a 30MB or 60MB hard disk.

The 30MB disk in our evaluation unit undoubtedly ranks among the slowest ever to find its way into a 386-class machine. The PC Labs benchmark tests place its average random access time at about 43 milliseconds, above the standard range even for an AT-class machine. The PC Labs DOS File Access tests showed throughput figures every bit as disappointing.

Inside the 55 SX case, you'll find little new to the PS/2 line, with the obvious exception of the Intel 386SX and a socket for the 16-MHz 80387SX math coprocessor, which IBM is offering with this machine at a price of $795.

Two 1MB SIMMs furnish the standard 2MB of RAM, which can be upgraded to 4MB on the system board and to 16MB via the expansion bus.

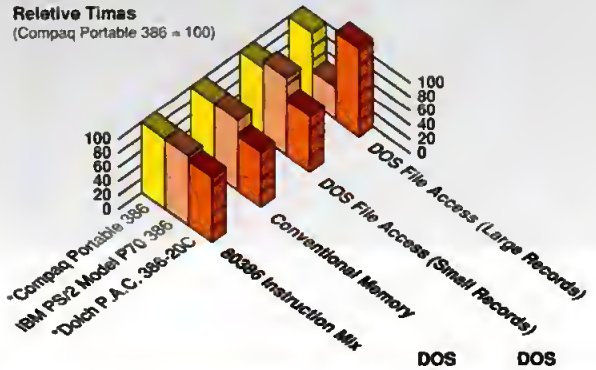
As with other PS/2s, the motherboard provides VGA graphics, a mini-DIN mouse port, one serial and one parallel port, and the floppy disk controller. A vertical removable I/O bus provides three horizontal 16-bit MCA slots, one with the video extension needed to accommodate the IBM 8514/A graphics adapter.

The bottom line? If you're looking for a travel-ready 386 machine, give the IBM PS/2 Model P70 386 a close look. Its price is attractive considering its features, and its performance and display are impressive for a portable.

As for the IBM PS/2 Model 55 SX, it would be difficult to take this machine seriously were it not for its IBM name. Its performance and expansion limitations position it as an entry-level machine, but IBM priced it out of the entry-level range. If you're sold on the idea of buying a 386SX, look elsewhere or wait until IBM lowers the 55 SX's price. ■

PC LABS BENCHMARK TESTS: IBM PS/2 MODEL P70 386

The performance of IBM's long-awaited PS/2 Model P70 386 places it solidly in the middle of its 20-MHz portable compatriots, reviewed in *PC Magazine*'s October 11, 1988, issue. But time stands still for no machine: the P70's 85-nanosecond memory and 27-millisecond hard disk aren't quite enough to overtake the more recent faster, leaner competition, such as the Toshiba T5200 (see First Looks in this issue).



Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)
*Compaq Portable 386	3.25	0.60	63.93	14.28
IBM PS/2 Model P70 386	3.24	0.60	70.24	6.58
*Dolch P.A.C. 386-20C	3.02	0.47	50.20	17.90

* This product was not reviewed, but we are reporting its test results for comparison

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The **80286 Instruction Mix** benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

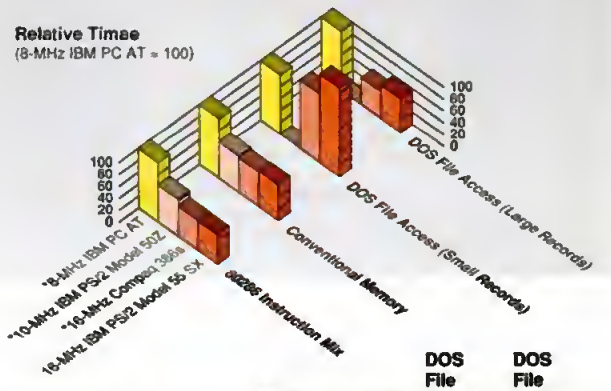
The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantegeous when large files are loaded.

IBM PS/2 MODEL 55 SX

Once again, IBM has decided to put a slow drive in an otherwise competitively fast machine: the PS/2 Model 55 SX's 44-millisecond hard disk performs even slower than the 8-MHz IBM PC AT in the DOS File Access (Small Records) test.



Performance Times (Times given in seconds)	80286 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)
*8-MHz IBM PC AT	8.96	1.32	54.32	16.22
*10-MHz IBM PS/2 Model 50Z	5.60	0.80	N/A	N/A
*16-MHz Compaq 386e	4.56	0.77	62.76	7.34
16-MHz IBM PS/2 Model 55 SX	4.50	0.80	81.09	9.31

N/A—Not applicable. this machine's disk times without cache were unavailable
* This product was not reviewed, but we are reporting its test results for comparison

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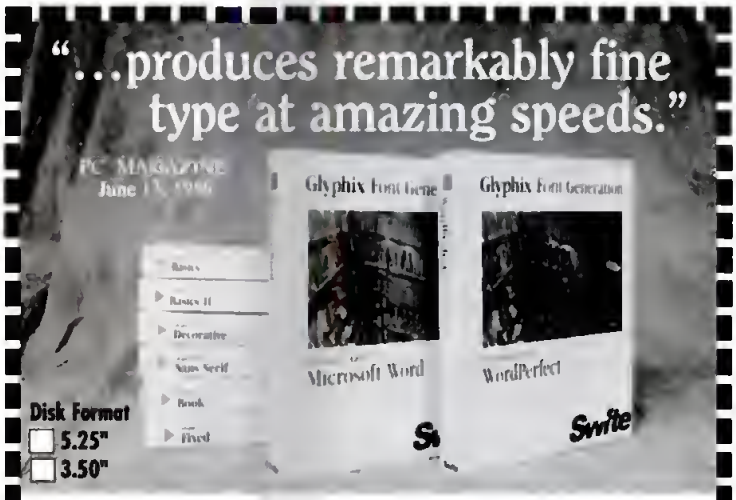

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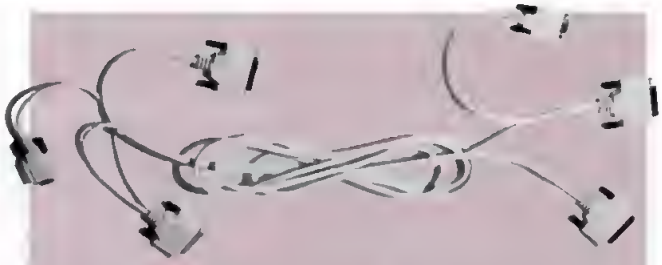
LapLink III Offers Serial and Parallel File Transfer, Remote Installation

HANDS ON
by Rock Miller

LapLink III, the latest version of Traveling Software's pioneering serial file-transfer package, incorporates several important new features into its trademark bidirectional design and split-window screen format. A new six-headed serial/parallel cable, which allows *LapLink* to install itself on a remote machine, and improvements to its file-transfer software make the $139.95 package even more convenient to use than its predecessor.



LapLink III takes the all-in-one approach with its new six-headed cable, which allows the product to install itself on a remote machine.

Experienced *LapLink* users will notice a few small differences in Version III. The new LL3.EXE program is a little bigger, taking up 90K of RAM instead of 63K. The program's single-letter commands are now all on a sliding menu, for one-key operation. When transferring files, you monitor your file's progress in bytes instead of blocks. And the program's configuration options are now divided by category.

But the program also comes with more-substantial goodies. First off, it has a new parallel mode that boosts the speed of large file transfers.

Unfortunately, *LapLink III* seems to have taken a small step backward on the serial side, at least under our test conditioos. Though it proved much faster at normal serial file transfers than *Lap-Link Plus*, when both programs were run in Turbo Mode (which uses larger blocks to decrease overhead) the new version was actually a little slower than the old.

LapLink III offers in convenience what it gives up in speed. The program's unique ability to clone itself can save the day if you don't have it handy on a floppy disk in the right format. Simply by pressing F10 at the opening screen and using a few DOS commands at the receiving end, you can get *LapLink* to install itself on a remote machine over the serial link.

This feature works only if you use *LapLink*'s new six-headed cable, which has seven wires instead of the normal three, to ensure data integrity in transferring the bootstrap program. And there's the rub, for the cable exacts a heavy toll on your back—1.2 pounds' worth, to be exact. Fortunately, the program still works with the old three-wire cable from *Lap-Link Plus* (which weighs only half a pound), and you may prefer this alternative if you're a weight-conscious traveler.

Traveling Software has also added a number of new features to *LapLink*'s file-transfer software that make it easier to use for backing up hard disks and transferring files automatically over serial networks.

Two new copy options, Overwrite Read-Only Files and Copy Files Only on Target, make it easier to duplicate your work on a remote machine. And if you have the vendor's *ViewLink*, you can use it to gather files together from the far reaches of your system into a single directory on your laptop, through *LapLink III*'s Xport/Import function.

But it is *LapLink III*'s new batch facility that will probably be the most helpful addition for most users. Backup scripts are stored in files on your disk and offer a subset of the options you'd have if you were running the transfer manually.

You can't tag files individually, but a Wildcopy option lets you copy files using the DOS wildcard specifications, and Dircopy lets you copy entire subdirectories by name. You can exclude a list of files or directories, too, and erase files in the current directory. You can set the program options and source and target directories separately for each batch.

Though each batch job handles only one copy session, you can chain batch jobs together to complete multiple-step jobs. You can also invoke and run batch jobs from the DOS prompt for powerful automated backup in batch files. The catch, however, is that *LapLink III* must be up and running on the other machine.

A new report function lets you keep track of what happened in a batch transfer by recording which files were copied and which weren't in an ASCII file on-disk. When used in conjunction with a Simulate Copy feature, this can be used to test your backup script without actually copying any files.

LapLink III isn't yet perfect. It still doesn't let you move files, and the batch erase feature works only on a single directory. And though its single-character commands are fast to use, they can be a little bit confusing to learn. Still, if you know and like *LapLink*, you can now get advanced features in your favorite package. ■

FACT FILE

LapLink III
Traveling Software Inc., 18702 North Creek Pkwy., Bothell, WA 98011; (206) 483-8088.
List Price: $139.95
Requires: 256K RAM, serial or parallel port, DOS 2.1 or later.
In Short: The newest version of this popular file-transfer package can install a copy of itself on a remote machine. A new six-headed cable allows for serial and parallel file transfers.

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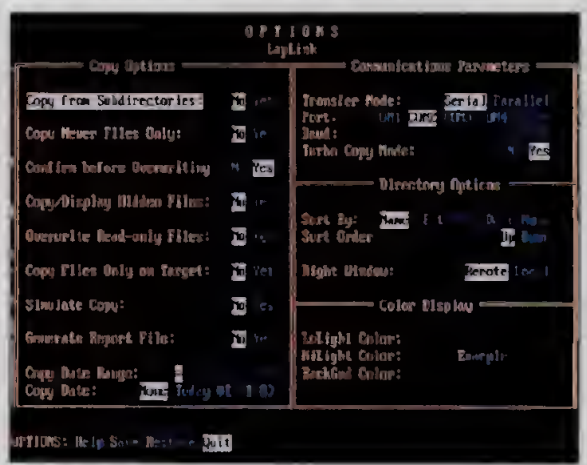

LapLink III's file tranafer software offers options that make it easier to duplicate your work on a remote PC.

PHOTOGRAPH: THOM O'CONNOR

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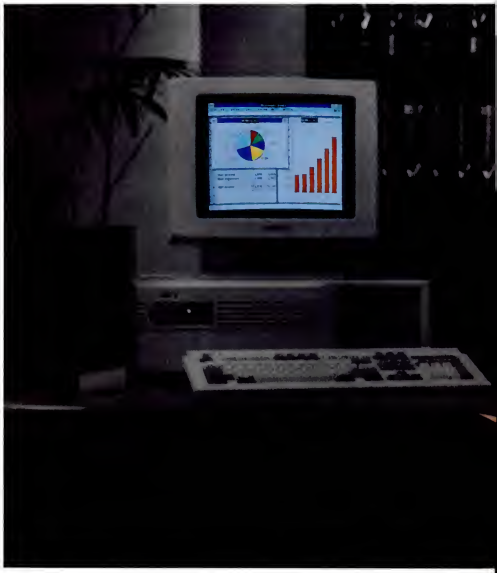

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become a national success.

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CIRCLE 394 ON READER SERVICE CARD

IN ALL FAIRNESS, YOU SHOULD READ WHAT ASHTON-TATE® IS SAYING BEFORE YOU PURCHASE ORACLE.

Ashton-Tate Fights SQL Bugs

Same Query Run Twice Can Result in Different Replies

Ashton-Tate last week acknowledged that the Structured Query Language (SQL) portion of dBASE IV can produce inconsistencies and inaccurate results.

The crux of the SQL problems lie with three anomalies that occur when data is structured in a specific way, according to Knox Richardson, a spokesman for the Torrance, Calif., firm. As a result, the same query run two different times can result in two different replies, for example, or a query can retrieve incomplete information from the database (See Chart, Page 8.)

Ashton-Tate does not plan to issue a dialerice to fix the problem; it is, however, offering workarounds solutions to users through its support lines and bulletin board, and on CompuServe, Richardson said.

Though Ashton-Tate is characterizing dBASE IV's SQL problems as "minor" and confined to specific circumstances, database experts claim their impact is more serious.

"The SQL in dBASE IV is unstable, unreliable and unpredictable," said Richard Finkelstein, president of Performance Computing Inc. a database consulting firm in Chicago.

"I don't see how anyone can use it," he added. "They'd have to know the answer to the SQL query ahead of time."

Surprisingly, the majority of dBASE users were unfazed by dBASE IV's SQL glitches.

"The drawbacks in SQL are an

See DBASE Page 8

PC Week, January 9, 1989

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20-MHz Toshiba T5200: High Performance at a High Price

HANDS ON
by Lori Grunin

If you're looking for a powerful desktop computer that can get up and go when you do, the transportable 20-MHz Toshiba T5200 will certainly fulfill your needs—assuming you don't balk at its price: $9,499 for the 40MB model, and $10,999 for the 100MB model.

Our evaluation unit of the 80386-based system sported a 25-millisecond 100MB hard disk drive, 4MB of 80-nanosecond RAM, and a 32K cache of 35-ns. SRAM. It raced through the PC Labs benchmark tests, performing better than its portable competition, as well as most of the 20-MHz desktop machines we've seen.

The base configuration includes 2MB of RAM and a 1.44MB floppy disk drive. Both the drives and the fan run exceptionally quietly. Perhaps too quietly: the machine gets very warm after only a short time.

The VGA-resolution gas-plasma display does a good job of rendering 16 shades of gray. You can't control the screen contrast, however, and it's capable of only two settings: bright and not-so-bright. The text font is slightly elongated and quite readable, but individual pixels are too discernible for comfortable long-term viewing.

On the other hand, if you're using the T5200 to double as your desktop system, you can easily detach the display and connect a standard VGA monitor to the system's RGB output port. But if you're not satisfied with the well-organized 91-key keyboard, you've no choice; the computer lacks an external keyboard connector.

As a desktop system, the T5200 is further constrained by the dual-function printer/external floppy disk drive port. In order to expand past the motherboard's maximum of 8MB of RAM and two slots (one full-length 16-bit, one half-length 8-bit/Toshiba 16-bit), you need to buy the $999 expansion chassis and a $199 interface card.

A disk-based setup program lets you allocate your system's memory among conventional, expanded, and extended and set other system parameters. You can also determine combinations of bus and CPU operating speeds; the bus can be slowed to an AT-compatible level, and 2 wait states can be inserted.

The T5200's relatively small footprint is the same as the T3200's—3.9 by 14.6 by 15.6 inches (HWD)—but this 19-pound computer isn't to be taken lightly. If you bruise easily, you'll probably want the optional carrying case (leather, $299; fabric, $99).

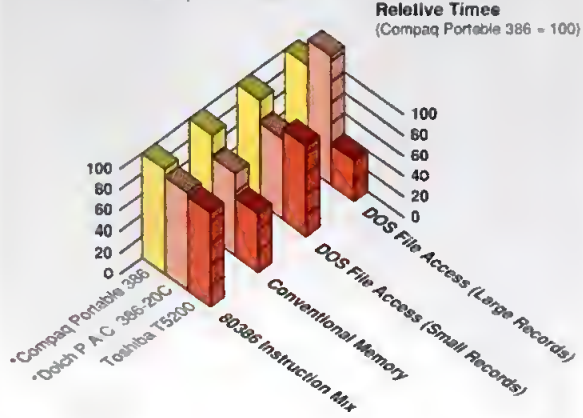
Nice touches include on-line hypertext DOS and system reference guides, a security tab for chaining the machine to your desk, and a combination lock to prevent unauthorized opening of the unit. The system comes with MS-DOS 3.3 and Quarterdeck Office Systems' *QEMM-386* memory manager. Toshiba offers its own version of OS/2 and a 1-year parts-and-labor warranty.

Toshiba has cleaned up many of the design flaws that afflicted the T5100, which should have turned the T5200 into the machine to beat in the portable category. Unfortunately, its price will keep most of the competition in the running. ■

Toshiba's T5200 puts the power of a 20-MHz 80386 into the small footprint of the T3200.

BENCHMARK TESTS: TOSHIBA T5200

Tha Toshiba T5200 performs faster than any machine in the last group of portables we raviewed (see "Taka It or Leave It: Portablas with Desktop Powar," *PC Magazine*, October 11, 1988); it should, in light of the steady improvement in memory and disk drive speeds since those raviews appeared. In fact, the T5200, with its 25-millisecond hard disk and 80-nanosecond memory, ranks roughly in tha top quarter of our recently tested 20-MHz desktop machines.



Performance Times (Times given in seconds)	80386 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)
*Compaq Portable 386	3.25	0.60	63.93	14.28
*Dolch P.A.C. 386-20C	3.02	0.47	50.20	17.90
Toshiba T5200	2.91	0.33	56.40	5.84

* This product was not reviewed, but we are reporting its test results for comparison.

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

FACT FILE

Toshiba T5200
Toshiba America Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; (714) 583-3000, (800) 457-7777
List Price: Toshiba T5200/40 (with 40MB drive), $9,499; T5200/100 (with 100MB drive), $10,999.
In Short: Toshiba's 20-MHz T5200 is a fast, well-built, but overpriced machine.

CIRCLE 454 ON READER SERVICE CARD

PHOTOGRAPH: THOM O'CONNOR

Arriba: An Electronic File Cabinet For Personal Information

HANDS ON
by Jonathan Matzkin

The best personal information managers fulfill several contradictory objectives. They are versatile enough to handle both structured and unstructured information, and they are also simple to use. That's a tall order, but it's one that *Arriba*, a $195 program from Good Software, tries to fill.

Arriba attempts to provide some of the data-management capabilities of high-end packages like Lotus's *Agenda* while maintaining the simplicity of note takers like Micro Logic's *Tornado* or Broderbund Software's *MemoryMate*.

At heart, *Arriba* is a full-text database. The metaphor it uses—a hierarchy of folders in a file cabinet—is simple, flexible, and robust. Folders accept information as free-form text or in a more structured format. *Arriba*'s preconfigured applications—phone manager, to-do list, and calendar/appointment scheduler—are folders set up to accept and organize specific information.

The applications have summary screens that display a view of the information stored in their folders and subfolders. When you select the phone manager from *Arriba*'s main menu, you see a sorted list of names and phone numbers. You can highlight an entry and auto-dial its number. You can also tap enter to access a text note, which *Arriba* automatically stores in a subfolder for each entry.

This linked-note feature makes *Arriba*'s phone-list manager especially powerful. Your time-and-date-stamped comments are permanently linked to the appropriate phone-list entry. To recall your last conversation with John Smith, for example, simply call up the phone dialer and display the subfolder associated with his entry.

The to-do list works in much the same way. A summary screen lists the person assigned to a task, a due date, a numerical priority, and a one-line description for each entry. The summary screen can be sorted on any of the entry headings. Pointing to a task and tapping Enter opens a blank note. Information in the note remains permanently associated with the task.

Arriba's calendar offers several advantages over the schedulers provided by many personal information managers and desktop organizers. For one thing, you can maintain multiple calendars. *Arriba*'s calendar also has a simple graphic that displays blocks of time that have been scheduled. You can link a text note to any appointment, so you aren't limited to writing a very brief description of an event.

Arriba's application generator lets you define your own application folder. This is particularly useful if you have specific tasks that generate predictable information.

The file cabinet that houses all of the folders is available as a choice on *Arriba*'s main menu. When you select the file cabinet, you get a list of folders, including the ones configured for specific applications. If you select the phone list folder, you end up in that application. But the file cabinet is more than just an application selector.

You can define a folder, with whatever title you choose, as a place to put free-form notes. This is useful for organizing the random pieces of information that might otherwise be strewn across your desk.

Unfortunately, there is no way to quickly open a free-form text note from *Arriba*'s main menu. You must first select the file cabinet, next choose a folder, and then open a note before you begin typing. That's too many keystrokes for what should be an instantaneous, spur-of-the-moment action.

Arriba's search capability is first-rate. From the main menu, you can enter any string of text, and the program creates a temporary folder with all of the subfolders that match the string. This feature is handy for finding a note or for consolidating phone calls, appointments, and tasks for a specific date.

To be most useful, *Arriba* should run as a memory-resident application. That costs you 200K, which is more RAM than you can probably spare. Support for extended or expanded memory would help.

Rather than forcing you to change your work habits, *Arriba* adjusts to your preferences. Better memory-management capabilities and main-menu access to note taking would make it an even more useful tool. ■

Arriba'a phone liat can be sorted on any of the main column headinga. A note can be linked to any antry.

Arriba'a appointment scheduler haa a aimple graphic that ahowa which blocks of time have been booked.

FACT FILE

Arriba
Good Software Corp., 13601 Preston Rd., #500W, Dallas, TX 75240; (214) 239-6085.
List Price: $195
Requires: 384K RAM (200K RAM when RAM resident), hard disk, DOS 2.0 or later.
In Short: An easy-to-use, moderately priced personal information manager that does well at integrating information from many sources but would be improved by better memory-management capabilities and main-menu access to note taking.

CIRCLE 447 ON READER SERVICE CARD

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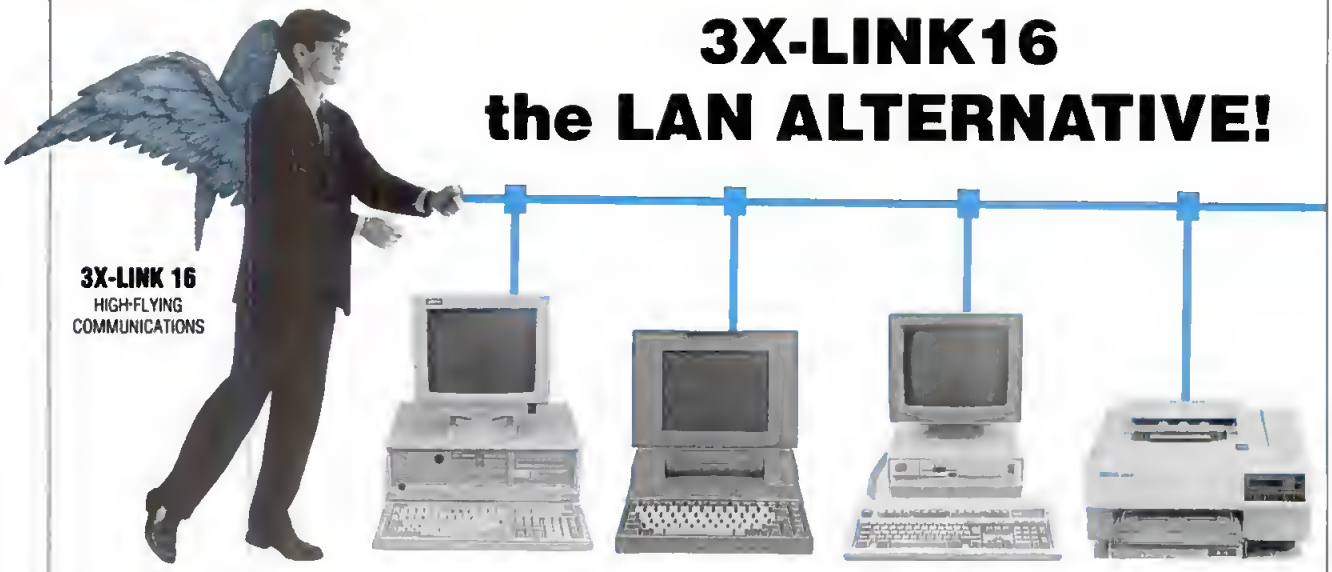

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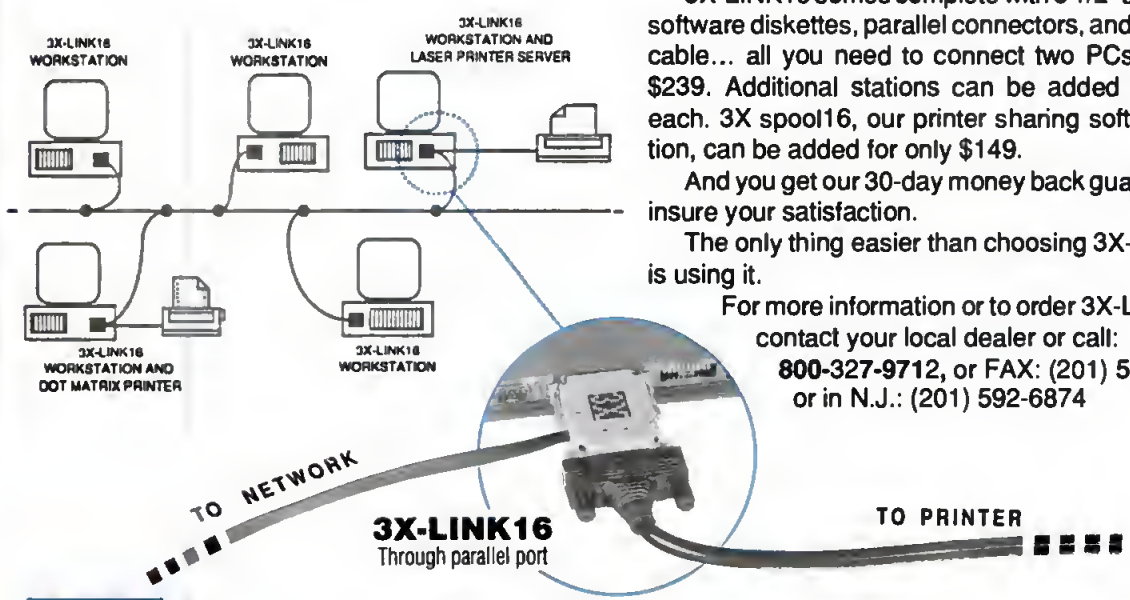

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CIRCLE 234 ON READER SERVICE CARD

Logitech Mouse Abandons Boxy Design

HANDS ON
by Jonathan Matzkin

Not so long ago, most PC users preferred having mice in the attic to finding the electronic analog next to their keyboards. But desktop publishing and graphical user interfaces have changed all that, encouraging mouse manufacturers to continue to improve the species. Logitech's new top-of-the-line mouse reflects the changes in mouse hardware and software that the last couple of years have brought about.

The most obvious difference between the new three-button Logitech Mouse (bus version, $129; serial PS/2 version, $139) and its predecessor is its shape. Following the example set by Microsoft, MSC, and several other manufacturers, Logitech has completely rethought the look and feel of its mouse. The result is a curved, streamlined design that has a space-age look.

The new design makes the mouse much more comfortable and efficient to use than its forerunner, allowing the palm of your hand to curve naturally over its body, and your fingers to fall easily on the three buttons. That's a big improvement over the previous Logitech's boxy shape, one of the few shortcomings in an otherwise excellent design.

Higher resolution and greater control over resolution add to the new mouse's appeal. Base hardware resolution is now 320 dots per inch, up from the 200 dpi offered by the older model. Of course, that means you won't have to move the mouse as much on your desktop to cover ground on-screen.

Logitech's *Click* software makes it easy to adjust the sensitivity of the device. You simply press Ctrl-Alt and the right button to raise the sensitivity and Ctrl-Alt and the left button to decrease it. Each click of the appropriate button generates a successively lower- or higher-pitched beep from your PC's speaker to indicate the increase or decrease in sensitivity, which varies from 50 to 19,200 dpi. You can change resolution on the fly from inside many application programs. The new mouse also sports a ballistic driver, which links speed of cursor movement to speed of mouse movement.

Logitech's mice have always been distinguished by the flexible, useful software that accompanies them. The new mouse comes with extensive menuing software, which is similar to previous releases. *Pop-Up DOS*, a DOS shell and desktop manager, is a new wrinkle. The mouse-driven shell manages files and offers a calculator, a calendar, a card file, and other *SideKick*-like capabilities. ■

The Logitech Mouse has a curved, streamlined design.

List Price: Logitech Mouse, bus version, $129; serial PS/2 version, $139. Upgrade for owners of previous Logitech mice, $89. **Requires:** 256K RAM (384K RAM with *Pop-Up Dos)*, 8-bit expansion slot, serial port or PS/2 mouse connector, DOS 2.1 or later. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; (415) 795-8500.

CIRCLE 446 ON READER SERVICE CARD

Practice Writing PostScript Programs Without a Printer

HANDS ON
by Edward Mendelson

PS Tutor cuts the price of learning PostScript by about $3,000. With Lincoln & Co.'s $119.95 package you don't need an expensive PostScript printer to create and view PostScript graphics and text. *PS Tutor* lets you write PostScript programs in its built-in editor, and then it immediately displays your work on-screen. You can also print your work on any non-PostScript printer that emulates Epson printers, the IBM Proprinter, or the HP LaserJet.

Using *PS Tutor* is like using the BASIC interpreter that comes with your computer. You can type in a simple one-line PostScript program and then see the results in a few seconds. As you learn more about the PostScript language, you can create a longer program in the editor and then run it to view the results on-screen. If you don't like what you see, a keystroke takes you back to the editor so you can modify the program and try again. When you're satisfied, you can store the program onto a disk for future use.

Unlike the BASIC interpreter, *PS Tutor* has extensive online help for all PostScript commands. Just press a function key and either type the first few letters of a command or select it from a list, and the program displays a brief explanation and example, complete with related error messages. A small set of sample PostScript files on the disk includes comments that help you master the basics and a few of the tricks of advanced PostScript programming.

PS Tutor comes with four fonts that let you combine graphics and text just as PostScript printers do. The fonts are far more coarse than Adobe's fonts, but they're good enough to practice with. The four correspond to the normal upright weight of Adobe's Times Roman, Helvetica, Courier, and Symbol fonts. You can supplement these with two optional add-on font packages: a $29.95 set of 9 fonts brings you up to the 13 fonts in the original Apple LaserWriter; a $69.95 set of 22 fonts, when combined with the fonts included in *PS Tutor* and those in the $29.95 set, gives you the full 35 fonts found in more-recent printers.

Don't expect to use *PS Tutor* as a preview screen for PostScript print files created by other applications. The DOS memory available to the program is too limited to let you load even the header files that most applications send to the printer before they start printing a document. But there's plenty of room to write and test complex PostScript procedures, which you can conveniently save in a library of routines to use in larger programs.

The weakest part of the program is the built-in editor. Its archaic mainframe-style interface constantly forces you to switch between a command mode and different modes for inserting or deleting text. *PS Tutor* lets you shell out to DOS, but it doesn't leave you enough available RAM to run anything but the tiniest editor in place of the program's own.

PS Tutor won't carry you into the deep waters of PostScript programming, but it's an inexpensive way to get your feet wet. ■

List Price: *PS Tutor*, with 4 fonts, $119.95. Additional font packages: 9 fonts, $29.95; 22 fonts, $69.95 (if purchased separate from *PS Tutor*, $39.95 and $89.95, respectively). **Requires:** 640K RAM; Hercules, EGA, or VGA monitor; DOS 2.1 or later. Lincoln & Co., 45 Winthrop St., Concord, MA 01742; (508) 369-1441.

CIRCLE 434 ON READER SERVICE CARD

PHOTOGRAPH: THOM O'CONNOR

Get out of the danger zone with Oracle's dBASE compiler

Announcing ORACLE Quicksilver

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Add connectivity to your dBASE applications today

Your ORACLE Quicksilver applications can talk to ORACLE SQL databases on your PC today. And with our optional networking software, you can build distributed databases across ORACLE servers on PCs, minis and mainframes—including IBM DB2 data

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*REQUIREMENTS: ORACLE SQL•Tutor: 256K PC and hard disk. ORACLE Quicksilver: To manage only dBASE DBF files and no ORACLE database, you need a 640K PC. To manage an ORACLE database on a remote computer, you need a 640K PC and optional networking software. To build an ORACLE database on your PC, you need a 286 or 386 PC with 640K plus 1MB of extended memory. All configurations require hard disks and DOS 3.0+.

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Lotus Prompt: One-Stop Shopping for Lotus Product Support

HANDS ON
by Gus Venditto

Ever wonder how strongly you're committed to Lotus software? Here's a litmus test. For a $995 annual subscription, you can get monthly deliveries of *Lotus Prompt*, with more than 60MB of documentation, compatibility reports, and device drivers on a CD-ROM disk.

Lotus gives you the deep background data that its technical support army has acquired over the years. Some of the tips are arcane, but many of the Technical Library tips are the meat and potatoes of product support.

What if you need to uninstall *Lotus 1-2-3* or *Symphony* and don't know which of several Setup disks to use? (The answer: Try looking at the hidden file on the Setup disk that stored the date and directory of the hard disk.)

How do you center headers and footers on a printout? (The answer: Use the vertical slashbar (|).)

Many of the tips address incompatibilities. Quite a few are basic, but anyone who answers questions on *1-2-3* or *Symphony* or who needs to keep those programs running with various PCs, printers, and networks will probably find *Lotus Prompt* worth the expense.

The biggest drawback is the slow access time of the CD player, but the search engine cuts through data quickly.

Of course, with so much data on-line, search problems arise. For instance, the Technical Library has compatibility reports on popular PCs, so you could search through the testing results on an IBM PS/2 Model 70 before you buy. If you used a simple query to look for "Model 70," you'd be told there was one matching document. You wouldn't, however, be directed toward a report about the difficulty of using a coprocessor on Models 70 and 80, unless you had searched for "Models 70," "PS/2," or another phrase in that report.

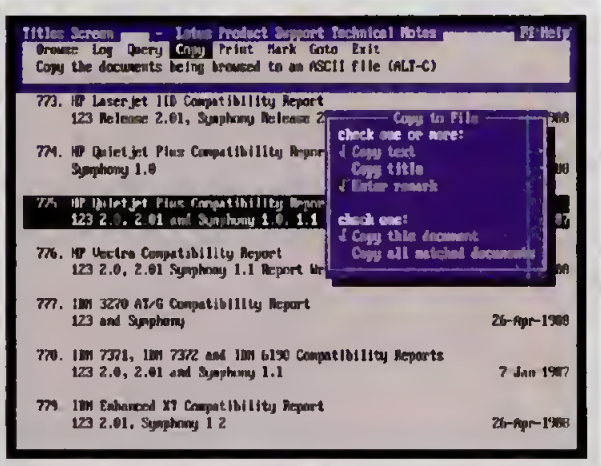
Almost as a bonus, the disks include demos and evaluation programs of newer Lotus products. On the April disk, you can step through a canned demo of *Agenda*, *Magellan*, *HAL*, *Metro* 1.0, *Symphony* 2.0, or *Freelance Plus* 3.0. Or, you can get a better feel for programs stored as evaluation programs, which retain the basic feel of the original, with key features disabled.

You could argue that Lotus ought to be providing all of this to its customers without charge, that it's all product support and users are entitled to it free.

You *could* argue that. But if you need the data, it'll cost you $995 a year. ■

List Price: *Lotus Prompt*, $995 for 12 monthly CDs. **Requires:** 640K RAM, High-Sierra–compatible CD-ROM drive and MS-DOS CD-ROM extensions, DOS 3.1 or later. Lotus Development Corp., 1 Cambridge Center, Cambridge, MA 02142; (617) 577-8500.

CIRCLE 432 ON READER SERVICE CARD



The *Lotus Prompt* shell provides searching, printing, and copying capabilities for a number of databases.

PHOTOGRAPH: THOM O'CONNOR

PC Librarian Catalogs and Warehouses Seldom-Used Files

HANDS ON
by Edward Mendelson

Your closets are probably packed with clothes that you haven't worn for years, but that you aren't ready to throw out either. Similarly, your hard disk is probably packed with old or rarely used files. United Software Security's $99 *PC Librarian* lets you warehouse these files on any storage medium, ranging from floppy disks to DAT cartridges. Its catalog of stored files lets you include descriptive notes so that you can retrieve a file by searching for a keyword even when you've forgotten the filename.

PC Librarian's usefulness isn't limited to dusty old files ready for cold storage. Because it lets you store and retrieve multiple versions of current work, you can use the program to maintain an audit trail of revisions to a file or to recover earlier versions of programming code. When you choose a filename from the catalog of stored files, the screen immediately displays a list of all versions of the same file, and you choose the one you want on the basis of its date, size, or optional annotation.

Unlike backup programs, *PC Librarian* can be told to delete the original version of the file from your hard disk as soon as the file is stored. For security, you can encrypt files as you store them; for economy, you can compress files in a minimum of disk space.

But like many backup programs, *PC Librarian* stores all the files archived during a single session in a single file on the storage disk. You need to use the program's menus, not a simple DOS command, to retrieve any individual file from the storage disks.

When you decide to move files into storage, you either type in a wildcard file specification, or specify a range of dates, or mark the files or subdirectory on the program's directory display—or any combination of these methods. You'll find that the directory tree is refreshingly easy to navigate, and when you want to view the tree of a different drive, you merely press its letter.

Convenient as it is, the first version of *PC Librarian* doesn't yet possess all the skills a computerized librarian needs. Although the program lets you look into a file to decide whether to store it, it lets you see only the first screenful of information. Although the box comes with 20 preprinted labels for storage disks, the program doesn't write a DOS volume label on the disks themselves. Unlike most backup programs, *PC Librarian* won't let you specify a list of files or directories for repeated archiving. You have to select the files or directories each time.

The program has an annoying habit of beeping at you almost every time you have to make a decision. Doesn't *PC Librarian* know that librarians are supposed to prefer silence? ■

List Price: *PC Librarian*, $99. **Requires:** 512K RAM, DOS 2.1 or later. United Software Security Inc., 8133 Leesburg Pike, Vienna, VA 22182; (800) 892-0007, (703) 556-0007.

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CIRCLE 163 ON READER SERVICE CARD

CrossView Offers Multidimensional Views and Analyses of Large Databases

HANDS ON
by Richard Hale Shaw

When you're confronted with a data-analysis problem, you typically think of using a spreadsheet or a database to get the answer. Unfortunately, spreadsheets restrict you to two or three dimensions and require a complex series of macros to manipulate data. High-end databases let you order or group data in many ways, but not without some programming effort. *CrossView*, from DataEase International, gives you something of the best of both of those worlds—without demanding that you be an accomplished statistician or programmer.

CrossView lets you create multidimensional views of your data. You can start with a two-dimensional (row-and-column) view of a database and progressively add new dimensions, or fields, to it. Each successive dimension orders and groups the data, and you can keep adding and manipulating dimensions at your whim. Since the program lets you create hierarchical relationships between fields as well as cross-reference and cross-tabulate information on the fly, it's an excellent tool for crunching numbers, tracking trends, preparing forecasts, or evaluating strategies.

In *CrossView*, a set of rows and columns is referred to as a page. When you add a third dimension (such as another field), you create a set of pages. By adding yet another field, you create multiple sets of pages, or a "hyperpage." Each time you add another dimension, you create another hyperpage layer.

In practice, the *CrossView* model might work this way: a simple, two-dimensional page might show the sales of several products and who sold them, with each product displayed as a row and each salesperson as a column. If you wanted to see this information grouped by the client stores that bought the products, you would designate the store field as a "page label," which would create multiple copies of the original page, one for each store. If you then wanted to order the information by month, you would designate the month field as a hyperpage label, thus creating a set of pages for each month, with each set consisting of a page for each store. The report generators of most database managers demand considerably more effort from you to produce a report like this. Moreover, you can select from over 30 computational functions, which can be nested to create complex field expressions, or you can continue to add dimensions should you need to do further analysis.

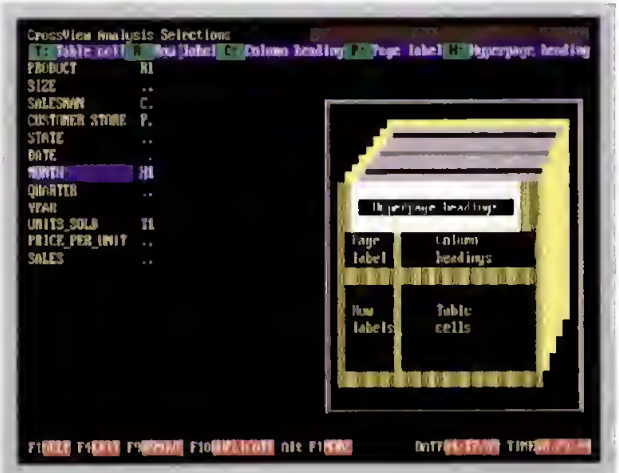
Other features make it easy to produce informative reports. You can configure such elements of the *CrossView* environment as screen colors and labels of each database field and save these in a profile. You can also set up a multiplier for the numeric fields, so *CrossView* will multiply each by a specific value. A Layout Editor lets you control how *CrossView* displays and formats each database field.

While it's easy to perform data analysis with *CrossView*, getting the data into the program in the first place is a fairly complicated task. *CrossView* will not read files other than those composed of fixed-length ASCII fields or those created with the vendor's own database manager, *DataEase*. If you wish to use the program with files created with other DBMSs, you'll have to transform them. First, you must export your data into an ASCII file, which almost every DBMS will do. Then you must create a *CrossView* data-definition file, which specifies the field lengths and fields in the file. Next, you must create a layout file to specify how *CrossView* will display the fields and format them on the screen. Finally, you have to run a utility to transform the data itself. This time-consuming and complex set of steps makes using the program more complicated than it should be. Considering that *CrossView* retails for a whopping $2,000, it's not out of line to expect it to convert the files or at the very least to make transforming them as painless as possible.

The program has other flaws. There doesn't seem to be any way to save an analysis model once you've defined it. You can print the results or export the model to a *Lotus 1-2-3* file, but you'll have to rebuild the model if you want to use it the next time you run *CrossView*. In addition, the interface for manipulating and viewing hyperpages is cumbersome. For example, you have to bring up a Zoom Menu to select the next page or hyperpage: Why not use the Arrow keys? You can look at only one page at a time, so it's too bad the program doesn't have a graphical interface that would permit you to view different pages in different windows.

Moreover, *CrossView* will only export *Lotus* spreadsheet files in .WKS format, not the more current .WK1 format that so many people use. The vendor leaves it to you to load *1-2-3* and then convert your worksheet to a .WK1 file format, which again is an inconvenience that a $2,000 package shouldn't put you through.

Despite these shortcomings (and its high price), *CrossView* is a tool needed by everyone who works with large databases. Its ability to perform multidimensional analyses on a database and change the relationships among dimensions on an ad hoc basis is not something you'll find anywhere else. ■



CrossView's Request Screen lets you create relationships among fields and dimensions with a few keystrokes.

FACT FILE

CrossView
DataEase International Inc., 7 Cambridge Dr., Trumbull, CT 06611; (800) 334-EASE, (203) 374-8000 (in Conn.).
List Price: $2,000; $2,500 if purchased with *DataEase*; LAN Server pack: up to six users, $3,000; each additional three users, $1,000.
Requires: 512K RAM (640K recommended), DOS 2.0 or later (hard disk recommended).
In Short: An expensive tool for analyzing relationships in large databases, offering multidimensional views of data. Works most easily with *DataEase* files and requires some effort to accommodate files from other DBMSs.

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CIRCLE 128 ON READER SERVICE CARD

by
Lori Grunin

New&Improved

News of Announced Products and Upgrades

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When operating on a fully charged battery, the LiteWrite outputs over 75 pages at a noise level of less than 60 decibels, according to Axonix. It comes with an AC adapter for more-strenuous jobs. Claimed speeds for the 9-pin impact dot matrix printer range from 100 characters per second in draft mode to 25 cps in NLQ mode. The LiteWrite emulates the Epson FX-100, IBM Proprinter, and IBM Graphics Printer.

When you need better-than-NLQ output, the ExpressWriter301 plain-paper thermal printer gives you 24-dot output at claimed speeds of 60 cps in draft mode and 42 cps in letter-quality mode. Maximum graphics resolution is 360 dpi. It runs on rechargeable nickel-cadmium batteries, which support 1 hour of continuous printing at a noise level of 47 decibels, according to the company. The printer emulates Toshiba, Qume, and the Epson LQ Series of 24-pin printers. Toshiba includes an AC adapter.

List Price: Axonix LiteWrite, $449. Axonix Corp., 2257 S. 1100 East, Salt Lake City, UT 84106.

CIRCLE 436 ON READER SERVICE CARD

List Price: Toshiba ExpressWriter301, $489. Toshiba America Inc., Information Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; (800) 457-7777.

CIRCLE 437 ON READER SERVICE CARD

Toshiba's thermal printer produces 24-dot output.

Hummingbird 50/60 Revs Your PS/2 to 20 MHz

NEW

If you're itching to squeeze more power out of your 16-MHz IBM PS/2 Model 50, 50Z, or 60, then the Hummingbird 50/60 provides one turbocharging solution. **Polywell's** $995 accelerator card adds a 32K cache of zero-wait-state 55-nanosecond static RAM and replaces your 16-MHz 80286 chip with a 20-MHz CMOS version. The result is a machine boosted to the level of a 20-MHz IBM PS/2 Model 70 or 80, according to the company.

To accomplish this feat, you remove your current chip from the motherboard and plug an adapter module into the socket. The Hummingbird card's two connectors plug into an expansion slot and the adapter. A Polywell utility allows you to disable the cache if you run into software-compatibility problems. The card comes with a chip puller and uses 11 watts of electricity.

List Price: Hummingbird 50/60, $995.
Requires: IBM PS/2 Models 50, 50Z, or 60.
Polywell Inc., 61 C Airport Blvd., South San Francisco, CA 94080; (415) 583-7222.

CIRCLE 438 ON READER SERVICE CARD

hDC Windows Color Gives Colors, Resolution Windows Forgot

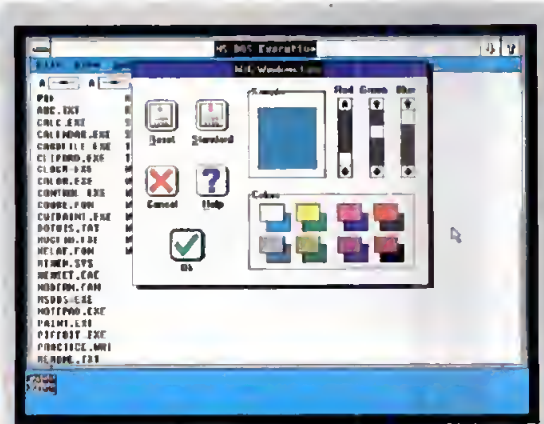
NEW

Microsoft Windows offers a graphical interface but forces you to live without 8 of the 16 available on-screen colors and settle for lower display resolution. If you'd like to put the color back into your *Windows*, **hDC Corp.** offers a software driver and a standalone utility that give you access to the 16 on-screen color capability available on your VGA or EGA system.

If you're running *Windows/386* with a VGA card and monitor, *hDC Windows Color* ($49.95) boosts your resolution to 640 by 480 from the 640 by 450 offered by *Windows:* EGA systems run at 640 by 350.

hDC Windows Color also allows you to

CONTINUES ON PAGE 54



***hDC Windows Color* lets you choose any 16 colors out of a palette of 64.**

New & Improved

hdc Windows Color

CONTINUED FROM PAGE 53

choose any 16 colors from a 64-color palette. The program is compatible with all current *Windows* applications, according to the company, and it requires the reinstallation of *Windows*.

List Price: *hDC Windows Color*, $49.95. **Requires:** *Microsoft Windows/266* or */386* 2.0 or later, EGA or VGA graphics card (hard disk recommended). hDC Computer Corp., 15379 NE 90th St., Redmond, WA 98052; (206) 885-5550.

CIRCLE 440 ON READER SERVICE CARD

Simple Win Simplifies Windows Use

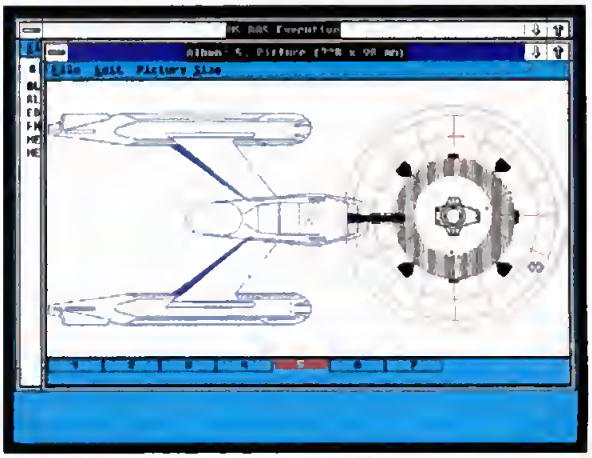
NEW

Users who wince at the text-based MS-DOS Executive that fronts *Microsoft Windows* supposedly graphical interface can customize their environment with *Simple Win*. The $99 *Windows* shell features an image album for transferring text and graphics among applications and the ability to launch and load applications by clicking on the data file.

The image album behaves the same way as *Windows*' own clipboard but stores up to 999 different objects. You can capture screens to the album, scroll through them and cut, copy, and paste library images into applications.

In addition, *Simple Win* offers a graphic menuing system that replaces the MS-DOS Executive and imports canned or user-created icons to represent your applications and data files. This system is called the Applications Organizer. With it you can organize your data files into folders, as well as password-protect specific applications or folders and add optional, customized help messages of up to 3 lines. Within folders, files can be listed with or without the explanatory text, and you can capture *Windows*' icons for use with *Simple Win*.

The shell's file manager displays a directory tree, and files can be either moved or copied by dragging icons from one directory to another.



***Simple Win*'s album can store up to 999 objects that can be displayed in a window and cut from or pasted to any application.**

Simple Win also integrates several DOS file and disk management commands, such as BACKUP, RESTORE, and FORMAT; you can selectively backup, for example, a single file, a single directory, or a directory plus its subdirectories.

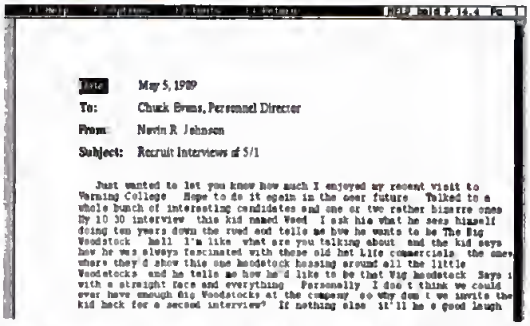
List Price: *Simple Win*, $99. **Requires:** AT-compatible system *Microsoft Windows/266* or */366*, graphics adapter. Matesys, 2001 L St., #801, Washington, D.C., 20036; (202) 785-5135.

CIRCLE 442 ON READER SERVICE CARD

IMPROVED

by Alan Cohen

***PFS: Professional Write*, Version 2.1**—The latest version of Software Publishing Corp.'s managerial word processor introduces a graphical page preview feature as well as expanded conversion formats, enhanced printer support, and simplified tab and margin control. Preview mode displays all point sizes, pitches, and type styles as well as line and page breaks; fonts may be changed during preview. For multiple-page documents, two pages can be viewed side by side. In addition, *PFS:Professional Write* has expanded its list of supported formats to include *WordPerfect* 5.0, *OfficeWriter* 6.0 and 6.1, *Microsoft Word* 4.0, and *PFS:First Choice* 3.0. Version 2.1 retails for $229; current *PFS:Professional Write* users can upgrade to the new release for $39. Software Publishing Corp., Mountain View, Calif.; (415) 335-2080.



Date: May 5, 1989
To: Chuck Evans, Personnel Director
From: Nevin R. Johnson
Subject: Recruit Interviews of 5/1

Just wanted to let you know how much I enjoyed my recent visit to Warning College. Hope to do it again in the near future. Talked to a whole bunch of interesting candidates and one or two rather bizarre ones. My 10:30 interview this kid named Weed. I ask him what he sees himself doing ten years down the road and tells me how he wants to be The Big Woodstock. Hell, I'm like, what are you talking about, and the kid says how he was always fascinated with those old hot tub commercials, the ones where they'd show this one headstock hassling around all the little Woodstocks, and he tells me how he'd like to be that Wig headstock. Says it with a straight face and everything. Personally, I don't think we could ever have enough Big Woodstocks at the company, so why don't we invite the kid back for a second interview? If nothing else, it'll be a good laugh.

***PFS:Professional Write* now offers a graphical preview feature.**

Bitstream Fonts for *WordStar* 5.5—Thanks to an agreement between MicroPro International and Bitstream Inc., purchasers of *WordStar* 5.5 will be able to receive the Bitstream Starter Kit—including a Fontware Installation Kit and the Swiss and Dutch typeface packages—for a $15 shipping charge. Using Fontware, *WordStar* users can scale outlines from Bitstream Scalable Typeface Packages to virtually any point size for a wide variety of printers, including the complete HP LaserJet family and all PostScript-compatible printers. To receive the Starter Kit, users need to return the coupon included inside each box of *WordStar* 5.5 or call (800) 227-5609. Bitstream Inc., Cambridge, Mass.; (617) 497-6222.

***MathCAD*, Version 2.5**—Additions to MathSoft's math software include 3-D plots, HPGL file import, PostScript support, sorting, multiple-region cut-and-paste, and pop-up menus. *MathCAD* 2.5 retails for $495. Owners of *MathCAD* 2.0 who purchased the product between May 1 and June 6, 1989, will receive a free upgrade to Version 2.5. Other *MathCAD* 2.0 users can obtain the upgrade for $149. *MathCAD* 1.1 users can upgrade for $175. MathSoft Inc., Cambridge, Mass.; (617) 577-1017.

***Lotus Manuscript*, Version 2.1**—With this enhanced version, users can create dynamic data links between the upcoming Releases 2.2 and 3.0 of *Lotus 1-2-3* and use shading to highlight sections of text or tables. The package also supports double-sided printing for the HP LaserJet IID and Canon LBP-8IIR printers. Also new is support for eight additional printers, including the Apple LaserWriter IINT and IINTX, the HP DeskJet Plus, and the IBM Personal Page Printer II. Lotus includes a coupon for a utility that converts files to and from most popular word-processing packages. *Manuscript* 2.1 sells for $495; upgrades cost $20 for users of Version 2.0 and $75 for users of Version 1.0. Lotus Development Corp., Cambridge, Mass.; (617) 577-8500.

CONTINUES ON PAGE 56

BORLAND INTRODUCES TURBO PASCAL 5.5 WITH OBJECTS

Be Objective.

Turbo Pascal,® the world-standard Pascal compiler, adds Object-Oriented Programming with our new version 5.5. We combined the simplicity of Apple's Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5, the object-oriented programming language for the rest of us.

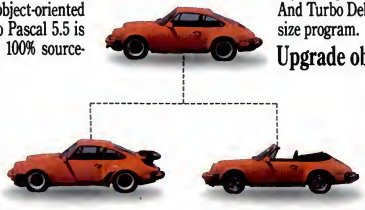
It's easy to extend yourself

If you're already programming with Turbo Pascal, it's easy to extend yourself from structured programming to object-oriented programming. And, Turbo Pascal 5.5 is the *only* compiler that is 100% source-code compatible with your existing Turbo Pascal 4.0 and 5.0 programs.

A fast object lesson

Object-oriented application programs more closely model the way you think. Objects contain both data and code. As in a spreadsheet cell, the value and the formula are together. Objects can *inherit* properties from other objects. For example, a Porsche Carrera inherits most attributes from the base model 911, but it also sports a whale tail.

Turbo Pascal 5.5's object-oriented extensions give you code that's easier to change, extend, and support.



Inheritance provides powerful modeling capabilities by allowing objects to inherit attributes from other objects.

Turbo Pascal 5.5 Professional with Turbo Debugger® and Turbo Assembler®

The award-winning Turbo Debugger now includes an object inspector and hierarchy browser. And Turbo Debugger can debug any size program.

Upgrade objectively

Pascal owners: Upgrading from Turbo Pascal 5.0 to 5.5 is only $34.95 plus $5 shipping and handling ($75 plus shipping and handling for owners of Turbo Pascal 4.0 or earlier). And upgrading from Turbo Pascal 5.0 and earlier to Turbo Pascal 5.5 Professional is only $99.95 plus $10 shipping and handling. To order, CALL (800) 331-0877.

Turbo Pascal 5.5 Features

- Inheritance
- Static & dynamic objects
- Constructors & Destructors
- Object constants
- Compiles @ > 34,000 lines/minute
- New integrated environment tutorial
- Hypertext Help with copy and paste
- Enhanced smart linker & overlay manager
- Support for 8087/80287/80387
- Integrated source-level debugging

BORLAND

Code: MA20

Mail upgrade orders to: Borland, P.O. Box 660001, Scotts Valley, CA 95066-0001. For orders outside the U.S., call (408) 438-5300.

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CIRCLE 377 ON READER SERVICE CARD

Our search program has your missing link.

You can automatically find all documents according to their content. Related words inside documents become your bridges between them. Or, you can design your own pathways through your data by creating hypertext links, then saving those links as **Hy**text™ files; you'll discover brand new ways to look at your database without getting hopelessly lost in a tangled web.

No more endless searches. No more missing links. With **Hy**text™.

Combines powerful full-text search engine with an intelligent linker so that you can automatically create your own hypertext system from existing documents.

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- Includes handy, on-line Notepad that you can link to specific documents
- Friendly windowing environment with easy-to-use pull-down menus
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San Antonio, Texas 78216

CIRCLE 159 ON READER SERVICE CARD

New & Improved

Mitsubishi Offers 26-Inch, High-Resolution Monitor

NEW

As CPUs shrink or move from the desktop to the floor, monitors seem to be growing to fill the space left behind. **Mitsubishi Electronics America**'s largest monitor to date, the 26-inch diagonal (25-inch viewable) HJ6505, gives you a 1,280- by 1,024-pixel display with a .31-millimeter dot pitch in exchange for eating up a little more desk space.

The $14,950 monitor works with any analog graphics card that outputs at resolutions between 1,024 by 768 and 1,280 by 1,024, noninterlaced. It automatically adjusts to the proper frequency: supported scanning frequencies range from 45 to 70 KHz horizontal and from 50 to 80 Hz vertical.

Mitsubishi's Dynamic Beam Focus technology reshapes elliptical dots into circular ones for greater accuracy. That lets the monitor attain a convergence of .3 mm in the center and .9 mm at the corners of the display, according to the company.

The auto-tracking Mitsubishi HJ6505 supports resolutions above 1,024 by 768.

List Price: Mitsubishi HJ6505, $14,950. Mitsubishi Electronics America Inc., Information Systems Division, 991 Knox St., Torrance, CA 90502; (213) 515-3993.

CIRCLE 438 ON READER SERVICE CARD

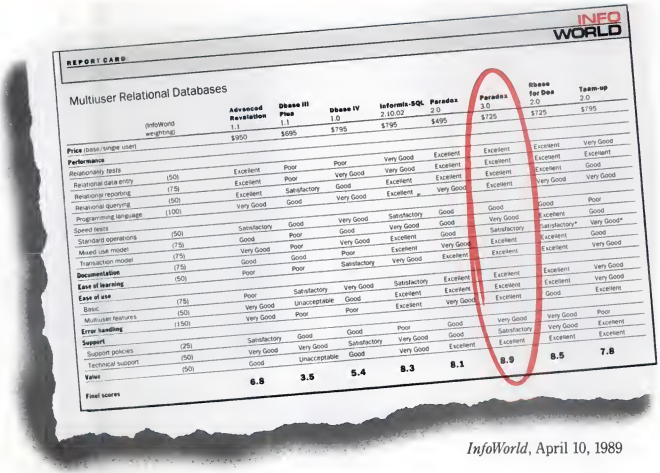
IMPROVED

CONTINUED FROM PAGE 54

***PictureIt*, Version 3.0, and VideoShow—General** Parametrics Corp. has added PS/2 compatibility to its VideoShow Operating System (VOS) and *PictureIt* presentation graphics software. The company's electronic presentation products are now compatible across the PC, PS/2, and Macintosh platforms. Two models of VideoShow for PS/2 systems are currently available: the VideoShow Professional, which retails for $8,995 (plus a memory surcharge of $440), and the VideoShow Executive, which sells for $3,995. *PictureIt* 3.0, which provides a palette of 5,000 simultaneous colors and support for fully scalable fonts, retails for $700. Presentations can be previewed and modified during creation, either on the PC's display or through VideoShow. General Parametrics Corp., Berkeley, Calif.; (415) 524-3950.

***Arts & Letters Graphics Editor* 2.0 allows users to import EPS-format files.**

***Arts & Letters Graphics Editor*, Version 2.0**—This upgraded version of the graphics package features spot and process color separations using the CMYK model, support of Matrix 35mm film recorders, and auto-trace for converting bitmapped images to objects. The new release also supports printer and downloadable fonts, and it includes new drawing tools such as an image hole-cutter. In addition, an import utility allows easier integration of images from clip art libraries. The *Graphics Editor* retails for $695; an upgrade to Version 2.0 is available for $50. Computer Support Group, Dallas, Tex.; (214) 661-8960.



INFO WORLD

REPORT CARD

Multiuser Relational Databases

	(InfoWorld weighting)	Advanced Revelation 1.1	Dbase III Plus 1.1	Dbase IV 1.0	Informix-SQL 2.10.02	Paradox 2.0	Paradox 3.0	Rbase for Dos 2.0	Team-up 2.0
Price (base/single user)		$950	$695	$795	$795	$495	$725	$725	$795
Performance									
Relationality tests	(50)	Excellent	Poor	Poor	Very Good	Excellent	Excellent	Excellent	Very Good
Relational data entry	(75)	Excellent	Poor	Very Good	Very Good	Excellent	Excellent	Excellent	Excellent
Relational reporting	(75)	Excellent	Satisfactory	Good	Excellent	Excellent	Excellent	Excellent	Good
Relational querying	(50)	Very Good	Good	Very Good	Excellent	Very Good	Excellent	Very Good	Very Good
Programming language	(100)								
Speed tests		Satisfactory	Good	Very Good	Satisfactory	Good	Good	Good	Poor
Standard operations	(50)	Good	Poor	Good	Very Good	Good	Very Good	Excellent	Good
Mixed use model	(75)	Very Good	Poor	Very Good	Excellent	Good	Satisfactory	Satisfactory*	Very Good*
Transaction model	(75)	Good	Good	Poor	Excellent	Very Good	Excellent	Excellent	Good
Documentation	(75)	Poor	Poor	Satisfactory	Very Good	Excellent	Excellent	Excellent	Very Good
Ease of learning	(50)								
Ease of use		Poor	Satisfactory	Very Good	Satisfactory	Excellent	Excellent	Excellent	Very Good
Basic	(75)	Very Good	Unacceptable	Good	Excellent	Excellent	Excellent	Good	Excellent
Multiuser features	(150)	Very Good	Poor	Poor	Excellent	Very Good			
Error handling									
Support	(25)				Poor	Good	Very Good	Very Good	Poor
Support policies	(50)	Satisfactory	Good	Good	Very Good	Good	Satisfactory	Very Good	Excellent
Technical support	(50)	Very Good	Very Good	Satisfactory	Very Good	Excellent	Excellent	Excellent	Excellent
Value		Good	Unacceptable	Good					
Final scores		**6.8**	**3.5**	**5.4**	**8.3**	**8.1**	**8.9**	**8.5**	**7.8**

InfoWorld, April 10, 1989

The bottom line is 8.9

InfoWorld magazine tested and compared multiuser databases. With a bottom line score of 8.9, Borland's new Paradox® 3.0 beat the well-knowns and unknowns hands down.

So read what *InfoWorld*'s Report Card says about relational databases—and if you'd like to try Paradox 3.0 first, there's one more thing you can do.

Call 800-345-2888, ext. 100. We'll send you a free Trial Version of Paradox 3.0 and a reprint of *InfoWorld's* multiuser database review.

BORLAND

Code: MP47

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CIRCLE 147 ON READER SERVICE CARD

KENSINGTON EXPERT MOUSE. THE REVOLUTION STARTS HERE.

Presenting Expert Mouse for the PS/2,® a revolutionary new input device. Remember how the mouse fundamentally changed the way we used computers? Now, Kensington revolutionizes the mouse with the introduction of Expert Mouse.™

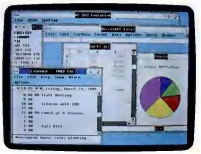
Since it's a trackball, it gives you greater control of your desk and your mouse because you move only the ball, not the entire mouse. Its size and shape allow your hand and wrist to rest comfortably while your fingers roll the trackball.

GET TO THE POINT. PRECISELY. QUICKLY.

Expert Mouse is precise and fast. Its patented optical technology positions the cursor exactly where you want it, and a unique feature called "click-lock" makes drawing, scrolling, and highlighting a breeze.

WORKS WELL WITH ALL YOUR SOFTWARE.

Expert Mouse is the ideal input device to use with any Microsoft Windows® application. In fact, Expert Mouse works with all the software packages that work with an ordinary mouse. And for applications not written with a



mouse in mind, Expert Mouse comes complete with programmable pop-up menus. These menus enable you to use Expert Mouse with already familiar programs, including Lotus 1-2-3® and WordPerfect®

MAKES YOU AN EXPERT.

Expert Mouse has a special automatic acceleration feature which senses your working speed. Roll the ball slowly for pin-point precision. Roll it quickly and the cursor will speed across the screen.

Expert Mouse—the next step in the revolution toward a better way of computing.

Expert Mouse is available at your favorite dealer. To find the dealer nearest you, call Kensington at 800-535-4242. In NY, call 212-475-5200, or write to us at Kensington, 251 Park Avenue South, New York, NY 10010.

KENSINGTON

Setting new standards of performance.

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New & Improved

MicroGate Combines Sync, Async Modems On One Card

NEW

If you don't like relinquishing one slot to a 3270 emulation board and another slot to a modem, you can reduce your slot sacrifice to a single board with the SyncLink Combo series of modems from **MicroGate Corp.** The $695 board comes in both PC- and PS/2-compatible models.

Each card features a 4,800-bit-per-second Bell 208/201–compatible synchronous modem and an on-board 2,400-bps asynchronous modem with V.22/V.22bis/Bell 212A and "AT" command-set compatibility.

MicroGate throws in one of its five micro-to-mainframe communications packages, which come in both binary synchronous and System Network Architecture (SNA) flavors. **List Price:** SyncLink Combo, $695. **Requires:** DOS 3.0 or later. RAM varies with selected communication package, DOS 3.0 or later. MicroGate Corp., 9501 Capital of Texas Hwy., Austin, TX 78759; (512) 345-7791.

CIRCLE 441 ON READER SERVICE CARD

XVT Helps Develop Portable Windows, Macintosh, PM Apps

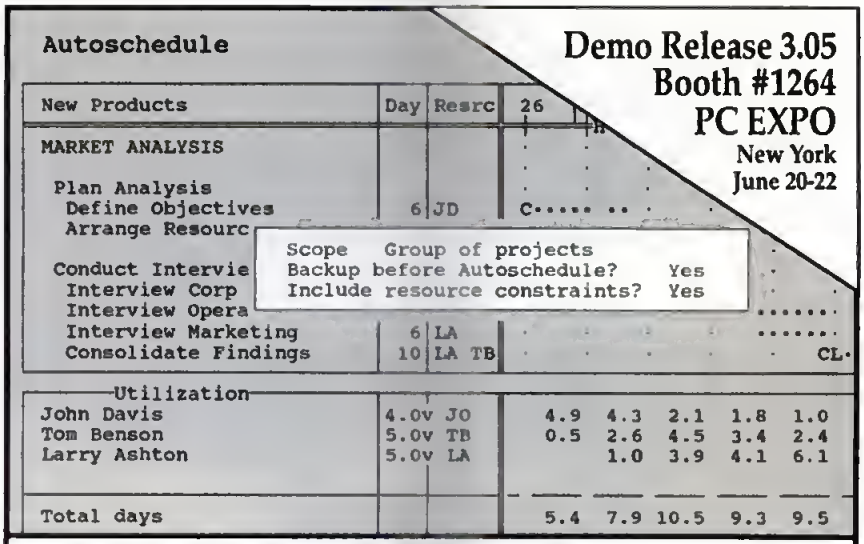
NEW

If you're a developer groaning in frustration over porting programs from GUI to GUI, then the *Extensible Virtual Toolkit* (*XVT*) from **Graphic Software Systems,** may be just what the doctor ordered. The $595 kit lets you create applications that are fully portable among the *Microsoft Windows*, *Presentation Manager*, and Macintosh environments, according to the company.

Each kit includes a library of high-level C functions that generate toolkit calls for the native environment. The *Windows XVT* supports Microsoft's *Windows/286* and */386* software developer's kits and Microsoft C. The *Presentation Manager* version supports Microsoft C, and the Microsoft and IBM OS/2 1.1 toolkits. The Macintosh version supports *Lightspeed C* and the MPW C compiler.

List Price: *Extensible Virtual Toolkit (XVT)*, $595 for each version. **Requires:** Environment dependent. Graphic Software Systems Inc., 9590 SW Gemini Dr., Beaverton, OR 97005; (503) 641-2200.

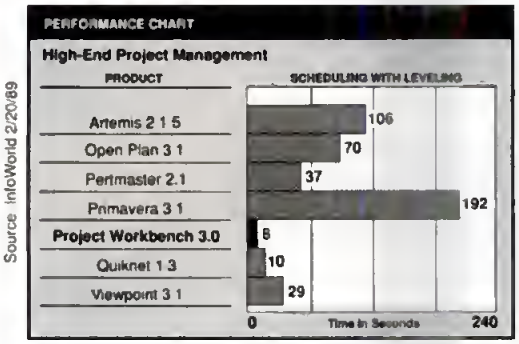
CIRCLE 444 ON READER SERVICE CARD



WANT A FAST DATE?

You could spend days trying to calculate your ideal project schedule. Or, you could let Project Workbench® Release 3.05 do it for you in seconds.

Offering much more than lightning-fast speed, the Project Workbench system is a complete project management toolkit that takes you from preliminary plan through management reports . . . and beyond.



Whether you are responsible for one project or an entire department, this micro-based system will revolutionize the way you manage people, time and money in 1989!

Fast, full-featured and easy to use, InfoWorld rated our speed and documentation "Excellent." They applauded features like interactive resource histograms and calendars, online actuals capture worksheet and context-sensitive Help.

FREE DEMO DISK
Call (212) 219-8945
or your local dealer

PROJECT WORKBENCH™
Software System from Applied Business Technology Corporation

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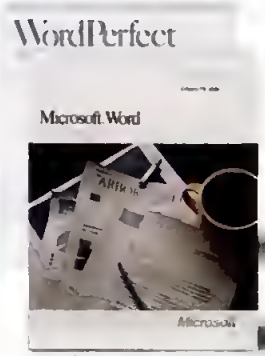
Project Workbench is a registered trademark of Applied Business Technology Corporation

CIRCLE 339 ON READER SERVICE CARD

If you want better word processing, don't settle for Perfect.

The trouble with WordPerfect® is, sometimes it isn't. Not when you compare it to our new Microsoft® Word version 5.0. Not when you consider that with Word 5.0, you'll pump out your day-to-day jobs quicker, easier, even smarter than you ever thought possible. On your IBM® PC or 100% compatible. It doesn't get much simpler than this.



Introducing new Microsoft Word 5.0. When Perfect just isn't good enough.

Example: With Word 5.0 you can choose commands by either using simple speed keys or just selecting from a menu.

You can tab, delete, italicize, move, change font and size, even cut and paste with about 50% fewer keystrokes than you-know-who.

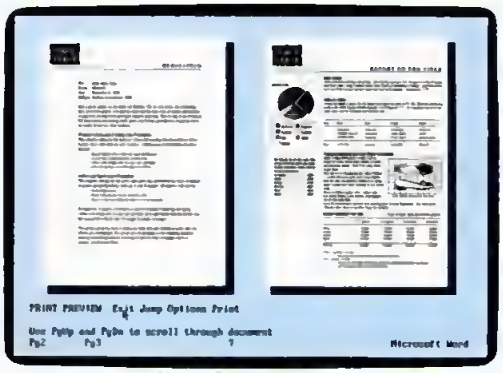
Your workgroup can even make any annotations right on a document, then you can merge and collect all the comments. WordPerfect? No comment.

You can also sort, list, search and archive files across multiple directories, on your PC or across a network, thanks to the Word 5.0 document management and retrieval system.

COMMON WORDPROCESSING TASKS

Which requires fewer keystrokes?	Microsoft Word 5.0	WordPerfect 5.0
Copy Block	4	7
Delete Line	2	4
Italicize Word	2	5
Change Font and Size	6	9
Add Footer	1	7
Box Paragraph	5	12
Total	20	44

With new Word 5.0 you'll do about 50% less hunting and pecking than with WordPerfect.



Word 5.0 Print Preview makes sure what you see is what you want. Before you print it.

Or incorporate part, or all of a Lotus® 1-2-3,® Microsoft Excel or Microsoft Works spreadsheet into a Word document. And then update it. In seconds.

All of which is reason enough to try new Word 5.0. But for those who need a little more

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ARBOR
FOOTWEAR

REPORT TO THE FIELD

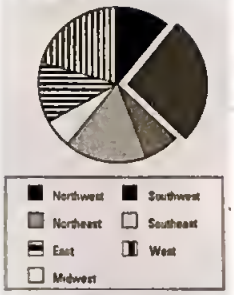
Shoe enough

Arbor Footwear comings and goings: **Jim** Dearing becomes V.P. Design **for Arbor Evening and Dress wear. Greg Vroonas** moves from Peoria to marketing in Miami. **Joan MacArthur and Lisa Doan** become account supervisor and media planner, respectively. *[illegible]*

Sales per region

Across the board it looks like **the South** once again led sales in FY '88. **With the** continuing pump craze those figures should maintain, if not improve. *[illegible]* It's important not to let the other areas such as Northeast and Midwest fall.

Sales per region



Style:	Dress	Sport	Career	Casual
	Evening oxl	Weekender	Tailor made	Trouser tip
	Midnight moccasin	Kickaround	Ladies wingtip	Loafer
	Twilight sockless	Runner up	M.B.A.-bound	Special spectator
Price:	$150-$350	$85-$125	$120-$250	$90-$150

The following are the most recent Telex numbers for the Arbor regional sales offices. All client and distributor inquiries should be directed to these numbers.

Los Angeles	06785
Atlanta	05786
Chicago	07658
New York	08657
Miami	05876
Detroit	06875

Young professionals use Arbor Walker to commute.

Soon, young professional women will no longer be using Arbor shoes simply to climb the corporate ladder. They'll be using them to get there.

This fall we're introducing the Arbor Walker — a shoe that goes quite a few steps further than the now-accepted but unattractive tennis shoes women have been wearing to and from work.

Made of Italian leather with a rubber sole, the Arbor Walker is the perfect combination of style and durability.

Arbor Walker designed by Pier Busto.

Look for promotional materials and carrying cases in early September. Our sales point is: "Women don't have to sacrifice looks for comfort."

SALES FORECAST FOR 1989 Types of shoes: Summer/Fall/Holiday/Spring

	1st quarter	2nd quarter	3rd quarter	4th quarter
Dress	95,000	87,000	120,000	60,000
Career	40,000	82,000	60,000	90,000
Casual	120,000	85,000	75,000	80,000
Sport	155,000	60,000	90,000	87,000
TOTAL:	390,000	314,000	345,000	317,000

[illegible] 9/27/88, 4:32 PM
let's discuss forecast for media department expansion
[illegible] 7/1/88, 1:15 PM
Figures for Northeast and Midwest should be calculated separately mid-month
let's catch them before they fall with promo

Text, graphics, fonts, annotations. Faster, simpler, cleaner. Compliments of new Microsoft Word 5.0.

convincing, picture this: Outline View. When creating longer documents, Outline View lets you switch to a view of headings only. Which means you can see the structure of your entire document, and rearrange it just by rearranging your headings.

We could go on and on with more advantages. But your best bet is to call for a convincing demo at: (800) 541-1261, Dept. J62. After you call us, try calling WordPerfect for a demo. Run both, our Word against theirs, head to head, and then ask yourself:

Which one brings your word processing closer to perfection?

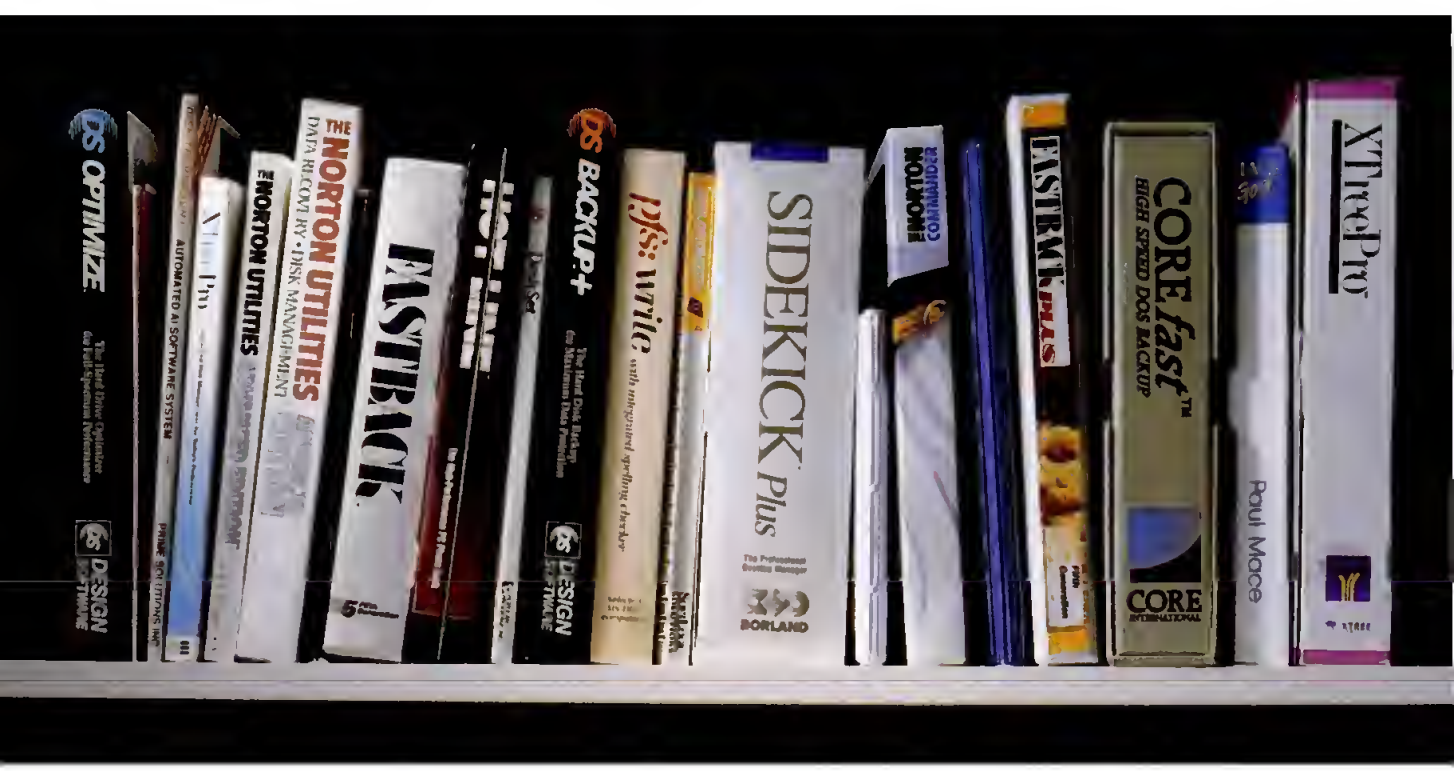
★★★★	8.4	Microsoft Word
★★★★	8.1	WordPerfect

Software Digest recently chose the best overall advanced word processor on the market. Who won? In a word, Word.

Microsoft®

Making it all make sense.

and 1-2-3 are registered trademarks of Lotus Development Corporation. WordPerfect is a registered trademark of WordPerfect Corporation. Customers in Canada, call (416) 673-7638. Outside North America, call (206) 882-8661. Software Digest rating from April 1989 issue. This offer valid only in the 50 United States.



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by Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer

LAN Manager File System Borrows Minicomputer Technology

OS/2 LAN Manager is now shipping from several vendors, but you'll have to look long and hard to find any truly new feature available in a LAN Manager–equipped system beyond the widely heralded Ashton-Tate/Microsoft SQL Server.

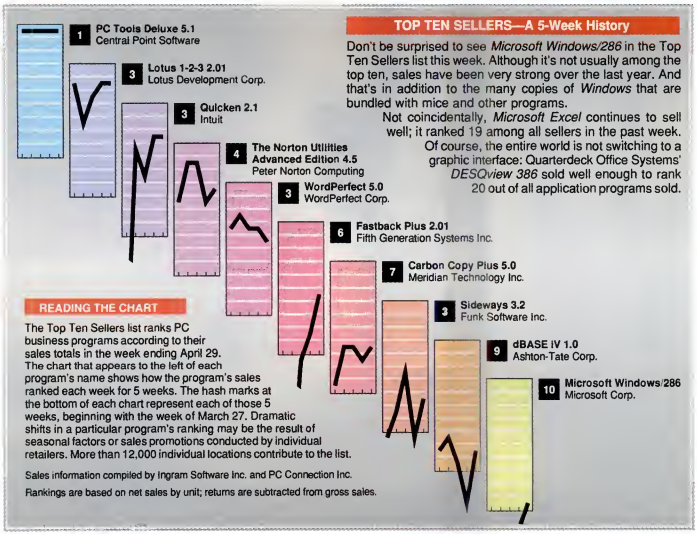
OS/2 LAN Manager can improve performance across a network, but the new platform is also supposed to provide rich new opportunities for software.

One startup venture is now showing a sophisticated application that takes advantage of the *LAN Manager* platform, and it will confirm a lot of the notions people already have about the OS/2 environment.

Saros Corp. of Bellevue, Washington, is using minicomputer techniques to provide distributed file services across a network. Its program, *FileShare*, establishes two separate servers for file management; one catalogs file attributes and the second stores the physical data. This heavy artillery can be run on one machine, but in the large network that such a system is going to be useful, you'd probably be maintaining three distinct servers: one for basic *LAN Manager* software and two more for the *FileShare* software.

The major benefit of the system is exhaustive file control; you can maintain up to 26 attributes per file, spelling out various uses for a file, and using icons if needed (it runs under *Microsoft Windows*). Of course, there are several levels of file security (they use an "owner-author-viewer"

CONTINUED ON PAGE 64



Pipeline

CONTINUED FROM PAGE 63

metaphor) and detailed backup/loss recovery features.

Because *FileShare* uses named pipes, it peacefully coexists with *LAN Manager*. At any given time, only a fraction of the network users may be using the *FileShare* services; the *LAN Manager* file system and applications continue unaffected. In a typical environment, only those users who work with very sensitive data will need to log into the *FileShare* system; others can go on with their networked applications that run unaffected off the *LAN Manager* server.

Clearly, this isn't a solution that will reach a wide share of the market. At $450 per station on top of the expense of running *LAN Manager*, *FileShare* is destined to be used only where there's heavy file sharing—in places where, until recently, only a minicomputer would do.

FileShare is destined to be used in places where, until recently, only a minicomputer would do.

OS/2: End of the Prologue

A 2-year effort to educate programmers in the inner workings of OS/2 has drawn to a close. Microsoft shipped the ninth and last batch of the MS OS/2 Software Developers Kit to more than 6,700 independent software developers in April.

The complete set comprised 160 disks with several OS/2 updates and tools for writing applications. Microsoft shipped more than 25,000 pages of documentation to each subscriber.

Current estimates say that about 70,000 copies of OS/2 have been sold at the retail level.

Microsoft will go through the same drill later this year when it distributes tools for the 386 version of OS/2.

IBM Working on DVI Hardware

In the December 13, 1988, issue's Pipeline, I previewed Intel's CD-DVI (compact disk, digital video interactive) technology, a system that generates television-quality full-motion video on programmable CDs.

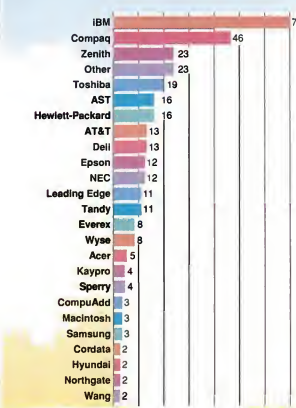
This spring, IBM has announced plans to develop a Micro Channel version of the technology. IBM will also join with Intel in establishing a Technology Center in Princeton, New Jersey, where RCA Labs developed DVI before Intel acquired it last year.

The joint IBM-Intel effort will encourage the development of DVI applications while the original DVI team continues to perfect it.

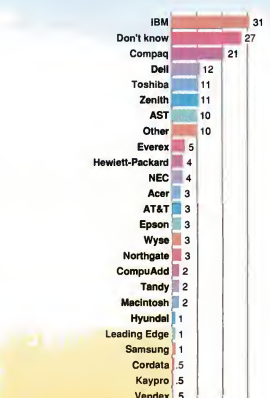
SURVEY

We recently surveyed callers to PC MagNet on their companies' current PC installations and purchase plans. More than 1,400 PC MagNet users responded and 92 percent of those claim their companies have plans to make further purchases within the next 12 months.

Which PC brands does your company own?



If your company plans to purchase PCs within the next 12 months, which brands does it plan to purchase?



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GERARD KUNKEL

AGE: "31, last March."

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CREDITS: Gerard's designs, both traditional and electronic, have graced publications from *Personal Computing* to *Business Week.*

LATEST PROJECT: Author of *Graphic Design in PostScript,*® published by Scott, Foresman & Co.

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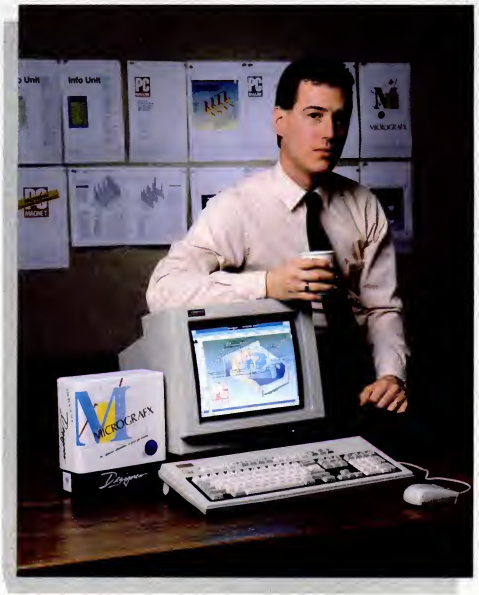

Gerard Kunkel, Director of Design & Electronic Publishing, Designer user

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Illustrations by Gary Kaplow
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DS7.1

Bill Machrone

Portable computers follow desktop machines too slavishly. It's time to rise up and surpass them.

Portables should do *Windows*. That is, they shouldn't just run *Microsoft Windows*, they should be optimized for it. Granted, today's GUIs are unsuitable for portables. They're disk hogs, and they require lots of caching or a RAMdisk to perform tolerably. So we dismiss them out of hand. But some of the best and most-exciting new software is *Windows* based.

You probably don't want to run *PageMaker* while you're on the road. But you do want to run the best personal information managers, word processors, and analytical software. *Windows* confers real benefits on even the most mundane of applications: a consistent user interface, the convenience of multiple windows, and multitasking. Heck, I'd much rather run *Microsoft Excel* on the road than boring old *Lotus 1-2-3*.

The NEC UltraLite and Tandy's *DeskMate* user interface offer two object lessons for building an advanced *Windows* portable. The UltraLite is nearly an instant-on machine, critically important when you get down to its size and weight. It lets you keep the machine handy to record an idea, check your schedule, or add something to work in progress.

With an UltraLite in tow, ideas happen at the speed of thought, not at the speed of a DOS boot. And equally important, it's instant-off. The machine's 2MB RAMdisk saves even the biggest files about as quickly as you can issue a command. No DOS machine can beat the UltraLite at this game.

The important thing about *DeskMate* is that Tandy, on its 1000 SL and TL, puts the whole thing—including DOS—in ROM. The result is an instantly booting desktop machine that offers all the benefits of a GUI, though it lacks *Windows* sophistication. In comparison to booting *DeskMate*, booting *Windows* is like watching a teenager combing his hair. Millions of CPU cycles go by, with great attention to doubtlessly important details, but to little noticeable effect.

Why couldn't this be done with *Windows?* With the advent of high-density ROMs, it's very practical to put *Windows* on a chip. Since the hardware environment in a laptop is a known quantity, you could do away with most of the configuration, font installation, and boot-up stuff that makes *Windows* so complex.

Microsoft could speed the process even more by cooperating with the laptop manufacturers. For example, it's possible to save a memory image of what *Windows* looks like after initialization. Laptop users could save a lot of time by loading that image instead of the programs that create it.

TIME TO BE DIFFERENT

Laptops also need to depart from desktop standards in their use of the real-time clock. Instead of treating the clock as a device that comes to life when the machine is turned on, you should be able to schedule it to turn the machine on and alert you to an appointment or run a program at specified times.

Sure, you can do this with any number of electronic calendars and appointment books or with devices like the Sharp Wizard. But at some point, this becomes an exercise in technonarcissism. I'd rather have one machine that does it all than be a walking Sharper Image catalog.

ILLUSTRATION: TOM LULEVITCH

Windows can help here, too. Through the Dynamic Data Exchange (DDE) specification, *Windows* programs can interact with other programs or with real-time devices. So at the proper time, *Windows* could boot, beep, and bug you. It would tell you what you need to know and shut off after your acknowledgment.

Finally, while the speed of the UltraLite's

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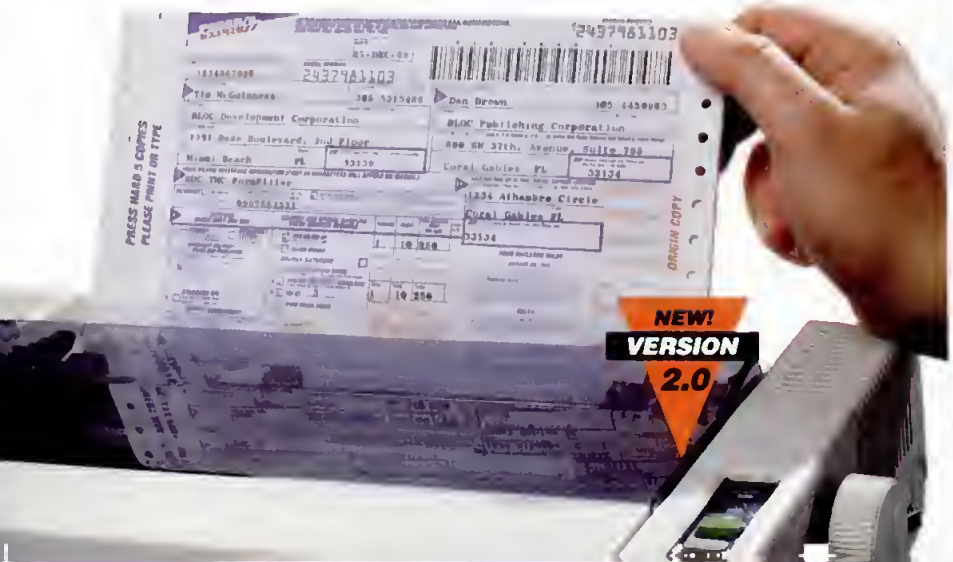

Bill Machrone

RAMdisk makes it ideal for recording the quick idea, it still requires a deliberate action on the part of the user. I'd like to see manufacturers build in a sleep mode, so that if you close the cover while your laptop's still on, it would go into hibernation, cutting the power to everything but main memory.

Of course, there is the hassle of pointing devices. Mice are impractical on portable PCs, so I'd vote instead for a touch-sensitive area about 2 inches on a side. While it's being touched, the Shift keys could serve as buttons. You could do clicks and double-clicks on the touch surface, but they'd have to build in some delays so that lifting and replacing your finger won't move the mouse cursor.

Let's dwell for a moment on the effect a *Windows* laptop would have on Apple. People have been clamoring for a Macintosh portable for as long as there have been Macintoshes, but the Mac's proprietary technology has been an insuperable barrier. In the face of Apple's belligerent litigiousness, there is no incentive to build a low-power chip set, to adapt the display, or to do any of the other engineering work that would be needed to build a battery-powered Mac.

So it falls to DOS machines to fill the gap. I won't claim for a moment that the *Windows* interface is anywhere near as whizzy as the Macintosh's. But once you get past the icons and the zooming windows, it does pretty much the same thing. With a few tweaks, *Windows* can be an environment that most Mac users would find pleasant and tolerable.

But wait, you say. What about Hypercard? Won't I want to get to some of those 230,000 Hypercard stacks out there? Yes, absolutely. But several not-yet-released *Windows*-based products address the Hypercard issue. One is a great retrieval engine and a wonderfully complete set of authoring tools. Another is a Hypercard clone (a superset, actually) that can read and write Mac Hypercard stacks directly. So I ask you: Who needs Apple?

We've been incredibly bad at predicting our own future. *Windows* was supposed to have crested this year, but it now looks as if it probably won't hit its stride until 1990. All of the good new applications are *Windows* based, and it's time for laptops to capitalize on them. ■

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John C. Dvorak

Looking to OS/2 for the next killer app is barking up the wrong tree. Here's where they really come from.

The personal computer industry is always hoping that someone will find a new "killer" application like *Lotus 1-2-3* or *dBASE II*, one that will reignite the flames of desire in the public and produce millions of dollars in wealth for the business. Right now, the pundits are pinning their dreams on OS/2, hoping upon hope that it will be the key to the next killer app.

Unfortunately, nobody in the industry seems to understand how these so-called killer apps come to be. It's really quite simple. All great new applications and their offspring derive from advances in the hardware technology of microcomputers, and nothing else. If there is no true advance in hardware technology, then no new applications emerge.

Let's look at the killer apps of the past and the hardware inventions that led to their development.

Invention number 1: the Altair personal computer. The killer app: Microsoft BASIC. The offspring: all microcomputer languages.

Invention number 2: the floppy disk. The killer apps: *Electric Pencil* and *WordStar*. The offspring: all PC word processing.

Invention number 3: the Apple II. The killer app: *VisiCalc*. The offspring: all first-generation spreadsheets.

Invention number 4: the hard disk. The killer app: *dBASE II*. The offspring: all PC database managers.

You can see the connection. Each killer software product is directly tied to a hardware advance. And note that these are not superficial changes, but fundamental improvements.

While you could always run a database manager from floppies, it took the hard disk to turn it into a killer app. This means that many killer apps are lurking in the background, awaiting the major technological breakthroughs that will make them happen. But it also means that increased speed or even RISC technology will not generate a new killer app. Floppy disk size doesn't matter, and neither does the operating system.

Once we understand this concept, we can look for the killer app by looking at new hardware technology. What do we see that's new? LANs? A mere variation on multiuser systems. This is a return to large systems and violates the general trend toward localized computing power. No killer app is possible from that invention. It's the same with color LCD portables; they're just desktop machines in a different form.

INNOVATIONS YET UNDREAMED OF

But what about CD-ROM? So far, it's just a slow read-only hard disk. But its ability to be mass-produced may invite a yet unknown application someday. ISDN? Now this is more than merely faster communication. It's a primary change, and it should produce a killer app when it gets going. Other areas of upcoming technological innovation to watch are holographic displays, wireless remote control, voice recognition, and scanner technology.

In fact, it's obvious that improvements in scanner technology will produce the next killer app, a fantastic OCR system. A bunch of pretenders are already lurking out there. But the good ones carry high prices, and the inexpensive ones are stuck with inadequate 300-dot-per-inch scanners.

ILLUSTRATION: TOM LULEVITCH

The key to killer applications is significant new technology entering the desktop market. It's not wishful thinking, and it's not the creativity of software engineers. Furthermore, the ratio of killer apps to technological advances is 1:1. The invention of the floppy disk didn't result in ten killer applications, but one: word processing. You only get one shot.

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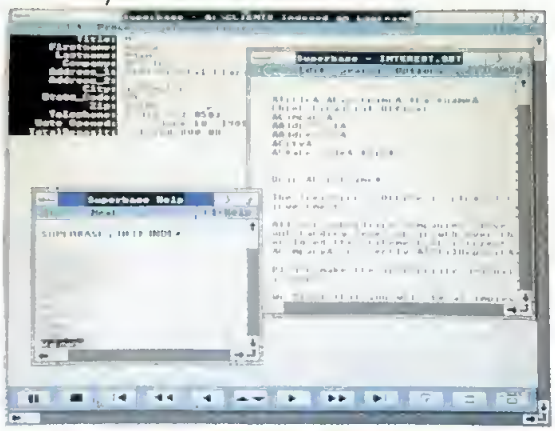

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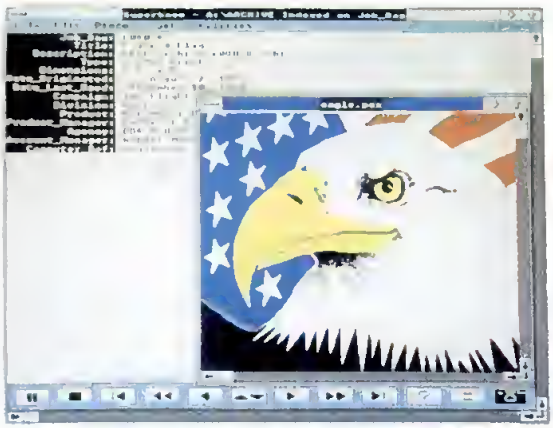

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CIRCLE 125 ON READER SERVICE CARD

John C.
Dvorak

Inside Track

I'm Sure He's Just Kidding Dept.: Apparently John Roach, the CEO of Tandy, has hinted that he might enforce some sort of **wacky patent** that GRiD (now owned by Tandy) has taken out for portable laptops. Somewhere along the line, it seems that the company obtained a patent for the hinged case design.

Of course, if a patent such as this is enforceable, then one can assume that someone in Silicon Valley will be able to pull out some notes showing that he or she invented the concept back in 1970 and is entitled to the patent, thus **forcing Tandy to pay royalties.** This kind of thing often happens with patents that are stupidly based on obvious design considerations.

A bigger picture seems to be emerging in the world of small computers, though. A genuine **mania for lawsuits** has been the theme of the business ever since IBM announced the MCA bus and its intent to litigate. IBM, it appears, is some sort of **moral leader**, and whatever it does, everyone else has to do. Even litigious Apple has swung for the fences with its *Microsoft Windows* suit, a bolder-than-normal maneuver.

The latest round of suits makes the old Lotus look-and-feel suit **look silly.** Now we have **Quarterdeck** announcing a patent on some windowing algorithms, claiming that violators will have to pay to use them. I looked at the patent and couldn't make heads or tails out of it. I heard that there was **panic** in the halls of Microsoft, though.

I find it **amusing** that Microsoft is the target of the two most interesting fights in the business: the Apple suit and now the Quarterdeck patent. Maybe the concept of karma does work as advertised. It was Bill Gates who, in a frenzy, **condemned the piracy** and blatant copying of his original Altair BASIC in the mid 1970s. What goes around comes around. Did I say that?

A third interesting suit involves idea man Paul Heckel and his *Zoomracks*, a cute database manager based on the concept of a card rack. He says it's the **progenitor of all hypercard programs,** and apparently some judges agree.

I don't know if any of this is all that good for the business. I do remember, though, years ago, when Vector Graphics was **sued** by Michael Shrayer for allegedly **copping some code** from his *Electric Pencil*, the first major word processor for a microcomputer. He lost and was countersued within an inch of his life. I played with both packages at the time and found they both had the same peculiar bug. **Seemed suspicious.** No matter—the courts said it was OK by them.

Since then, there has been a curious case involving TRS-80 **operating system clones** that gained much notoriety in the early 1980s. Apparently Radio Shack had buried some **scrambled code** in the OS that would reveal a company message if you pressed a **peculiar combination** of keys. Guess what happened when you pressed the same peculiar combination of keys on a couple of the clone operating systems? Yes, the Tandy message appeared. Nonetheless, the courts didn't think that any copyright was violated.

Until recently, only Apple, which relied on patent laws to enforce the Apple II's stranglehold on its market, seemed to make any headway with **litigation.** Suddenly, along came "look and feel" and a slew of vendors opting for finding a way to patent things. That's not good.

So looking back on the possibility of gaining an enforceable patent for the hinged laptop case leads me to think of all sorts of other possibilities. Who can say, perhaps the A> prompt might be patentable? And what about the detachable keyboard? The **great** thing about patents is that you can apply for one even after years have passed by, as long as you can prove that you invented it first.

Who can say, perhaps the A> prompt might be patentable? And what about the detachable keyboard?

Maybe someone out there will discover that he or she **invented the reset button,** for example. Hey, think about the royalties for that invention! What about diskette labels, or long cables for keyboards? There must be a million little items that can be patented just like the hinges on a laptop. What about colored diskettes? Yo! **Centech,** here's where you can make some real dough! Enough said.

Cheap Optical Character Recognition Dept.: Well, well. It seems that a hot product for the Mac—*OmniPage* from **Caere,** a superb OCR program—is now being ported to 386 machines. I've had only a demo to play with, but I'd say that Kurzweil might want to think about lowering its prices to meet the sub-$1,000 prices of the Caere product.

There are now **three main players in PC OCR:** Kurzweil, Calera, and Caere. A fourth product, *CAT Reader*, from Computer Aided Technology, lurks in the background. If you read my column, you'll see why I think OCR software is the next hot thing for the PC. The market should be **enormous.** First of all, desktop publishing users will need it to scan items into their documents. Usually a desktop publishing system has a scanner already, so the sales are automatic.

I use *OmniPage* to scan in documents that I cannot get electronically. **Who wants to rekey data** in this day and age? Nobody. It saves enough money in time saved to pay for itself. No office should be without this stuff at these prices. A few years ago an OCR machine might cost **$30,000** or more, and it could still read only special OCR-type ball printouts. It was **pathetic.** Times have changed. ■

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PROJECT MANAGEMENT

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Ken Stowe is scheduling manager of Pizzagalli Construction in South Burlington, Vermont. Pizzagalli just completed a $20 million addition at Duke University.

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CIRCLE 148 ON READER SERVICE CARD

Jim Seymour

Straight talk—with some clear definitions—about the uses and abuses of PC-based desktop presentations.

In the never-ending search for the next hot application category, one has edged to the fore over the past year and a half: desktop presentations.

I like desktop presentations as much as the next PC user, I suppose—I certainly do a lot of work that people tell me is of that genre. But I think the term *desktop presentation* is in need of some better definitions. Some straight talk about the strengths and weaknesses of IBM-standard PCs as development and delivery systems for desktop presentations would also help.

Just what do people mean when they speak about desktop presentations? To my mind, two very different activities are subsumed under that catchall phrase.

The first meaning refers to the use of a desktop computer to prepare presentation materials. These materials might include 35mm slides, overhead transparencies, flip-books, speakers' notes, and handouts. In this sense we're talking about using a PC as a development system, or maybe a production workstation, to crank out traditional presenters' aids that will be used in traditional ways.

The second use of the term refers to the actual *presentation* of materials on a personal computer—turning a PC into a delivery system. For a prescription-drugs manufacturer's detail man, for example, that might mean sitting across from Dr. X in his office and flipping through a series of electronic "overheads" on a laptop PC while touting a new drug. For an architect, it might mean sitting down at a PC, with clients peering over his shoulder, and running through a series of walk-through views of an unbuilt structure—views constructed with a 3-D CADD program, of course.

I'm a big believer in the first kind of desktop presentation work—using a PC to produce speakers' aids. Though we're now seeing a small flood of desktop-presentation software meant to help users create those slides, overheads, and the rest, the truth is that we hardly need special software for most jobs.

I've produced literally hundreds of very good-looking overhead transparencies, for example, with standard word-processing, graphics, and occasionally desktop publishing programs running on a PC connected to a laser printer. And I've made a few thousand 35mm slides on PCs connected to Matrix and Mirus film recorders, using standard PC graphics programs such as *Harvard Graphics* and *Pixie*.

FINE CONTROL, SPECTACULAR EFFECTS

The flood of new packages for producing presentation materials, from *Xerox Presents* to the forthcoming PC versions of Aldus's *Persuasion* and Microsoft's *PowerPoint*, do allow much-finer control and more-spectacular effects, such as color-graduated backgrounds, drop shadows on lettering, infinitely variable type sizes, and so on. And they include features that automatically produce speakers' notes, handouts, and other supporting tools. So I suspect I'll adopt one or two of those packages, as well.

I'm much less taken, though, with the idea of *showing* on a PC the material I *produce* with a PC. I've done a few of these exercises. And I've seen other people's "desktop playbacks."

ILLUSTRATION TOM LULEVITCH

Every time, I've bemoaned the PC's lack of graphical support, the slow screen refreshes, the limited viewing angle, brightness, and color palette. Putting these presentations on a video projector solved the image-size problem but it made things even dimmer and fuzzier. Running them through a VideoShow was not much better.

Hauling around a PC for slide shows is far clumsier than carrying a Carousel slide projec-

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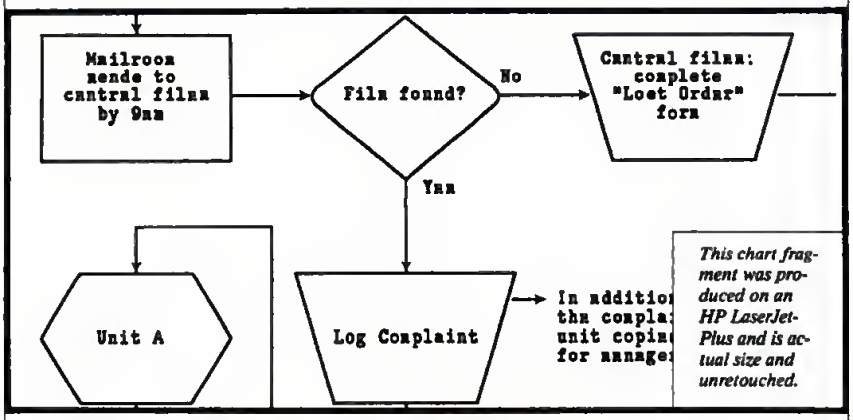

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CIRCLE 201 ON READER SERVICE CARD

Jim Seymour

tor. And if you don't want to carry your projection system, you're a lot likelier to find the right Carousel and screen at a distant location than the right PC, monitor, and video board.

INHERENT INEFFICIENCIES

The problem with PC-based desktop presentations lies partly in the inherent inefficiencies of running slide shows on a computer and partly in our unreasonable demands on systems never meant for this kind of work.

Hauling around a PC for slide shows is far clumsier than carrying a Carousel slide projector.

Goosing up the power of PCs with 386 chips and throwing a semigraphical interface shell onto the machine (in the form of *Microsoft Windows*) still doesn't make the PC a very good graphics platform. Desktop presentations—and here I mean the second use of the term: *showing* the materials on a PC—are vastly more impressive on, say, a big-screen Mac II than on any PC made today.

We can live with the PC's graphically limited powers when we're creating speaking aids: we soon learn how the finished results will *really* look versus how they look on-screen on the PC. Limited screen sizes, slow screen redraws, and the rest of the PC's impediments to effective *presentation* of visual materials hardly matter at the design and production stages.

So I'll continue producing presentations at my desktop, thank you; and I'll embrace the new software tools that come along to help my trusty 386 crank 'em out. But don't look for me in your reception room, disk in hand and portable PC under my arm, ready to sit down and dazzle you across your desk—because there isn't much dazzle in presenting desktop presentations on the desktop. ■

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CIRCLE 473 ON READER SERVICE CARD

William F. Zachmann

In the contest between OS/2 and Unix, users can eat their cake and have it too.

Are OS/2 and Unix really deadly rivals in the battle to replace MS-DOS as the dominant desktop operating system for the 1990s? It would be easy enough to get that impression, based upon much of what has been written on the subject over the past year. What's more, vendors like Sun Microsystems and NeXT have been aggressively promoting their Unix-based systems as alternatives to personal computers running OS/2.

There is no denying that Unix and OS/2 *are* competitors in some cases. Both can be used as the base operating system for desktop personal computers, workstations, and network servers. But to view OS/2 and Unix as mutually exclusive choices in a zero-sum game makes very little sense. On the contrary, only if we regard OS/2 and Unix as partners—and even as complementary operating systems—can we make the best use of these emerging technologies.

HERE BUT YET FORGOTTEN

The "OS/2 vs. Unix" hype seriously obscures Unix's greatest value—as an alternative to proprietary multiuser operating systems. Although network architectures certainly hold enormous promise for the future, the bulk of information processing in business still takes place on character-mode terminals attached to mainframe and minicomputer systems, and this is likely to remain the case for some time. In this arena, Unix has advantages that OS/2, as a single-user operating system, cannot offer at all.

The proprietary architectures of traditional systems have historically created a strongly fragmented market, subject to very limited competition. The semimonopolistic pricing that helps keep mainframe and minicomputer systems as expensive as they are is one result of this segmentation.

Today, microprocessor-based alternatives to these traditional systems, in products like the NCR Tower, the transaction processing systems from Stratus and Sequent, and the growing number of offerings from traditional vendors like Unisys, Hewlett-Packard, and Bull offer the capabilities of minicomputers and mainframes at microprocessor costs. Unix is, without a doubt, the standard multiuser operating system for these increasingly powerful and much more economical systems.

For this reason, even if Unix never ran on a single desktop system or network server, it would still provide enormous benefits to business users. The potential payoff from Unix as a standard multiuser operating system far outweighs whatever it may deliver on the desktop, at least in the near future.

THE REAL RIVALRY

To focus exclusively on areas in which OS/2 and Unix are potential competitors is to overlook the area in which Unix delivers its most obvious and most demonstrable benefits. The real rivalry is not between Unix and OS/2 but between Unix and traditional proprietary operating systems. And this is an arena in which Unix is sure to be the winner.

To take a prominent example, microprocessor-based Unix systems offer an extremely attractive alternative to IBM's AS/400 system. Not only are they far less expensive initially,

ILLUSTRATION: TOM LULEVITCH

but users opting for Unix gain the ability to port their software to other platforms in the future. This stands in sharp contrast to the costly long-term lock that IBM's proprietary architecture and operating system impose on its AS/400 users.

Though users already committed to the IBM System/38 architecture might prefer to continue down that road, migrating from the System/36 to the AS/400 is a much bigger jump, with sub-

stantial additional costs. For these users, a Unix-based system can be significantly more economical.

PEACEFUL COEXISTENCE

Even where OS/2 and Unix do compete—on the desktop and under the covers of the network server—there is no necessity to choose one exclusively over the other. There are many ways to treat them as complementary options, thereby giving users the freedom to choose their systems based on their particular tasks' requirements.

First, a common user interface is now provided by *Microsoft Windows*, the OS/2 Presentation Manager, and the Open Software Foundation's *OSF/Motif* for Unix. Even though there are differences in the application program interface (API) for these three systems, they are similar enough that applications can function identically, from a user's perspective, in all three environments.

In fact, the same API can even be shared between OS/2 and Unix, either by using an *X/Windows* server running under OS/2 or by using the PM/X interface for Unix developed by Microsoft and Hewlett-Packard to run Presentation Manager applications on Unix systems.

Second, the availability of common network interfaces, such as the *OS/2 LAN Manager* software for Unix, will ensure that individual MS-DOS, OS/2, and Unix systems will be able to communicate with one another. It won't matter which operating system a workstation or server runs—it will still be able to participate fully in distributed operations with the other stations on the network.

FREEDOM OF CHOICE

With the emergence of such shared standards, users will be free to implement whatever combination of DOS, OS/2, and Unix systems provides the most effective response to their organizational requirements. They will be able to mix and match personal computers, workstations, and file servers running any combination of the three operating systems and at the same time preserve software compatibility.

At no point will it be necessary for an entire organization to choose between OS/2 and Unix. Instead, software requirements will determine the choices. Such issues as compatibility with existing applications and which software best meets which needs will be more important than which operating system is used.

While it seems likely that most of the PCs currently running DOS will migrate to OS/2 eventually, they will need to do so only if OS/2 provides a better desktop environment than Unix does. My view is that, for the most part, it probably will. But whatever happens, both OS/2 and Unix can coexist within the same environment, and both offer an effective way to replace traditional mainframes and minicomputers with microprocessor-based systems.

The "religious" wars between OS/2 and Unix may make good copy for writers, but viewing the operating systems as combatants doesn't make good sense for users. It makes much more sense to see OS/2 and Unix as partners in the overthrow of the old order of expensive proprietary systems. ■

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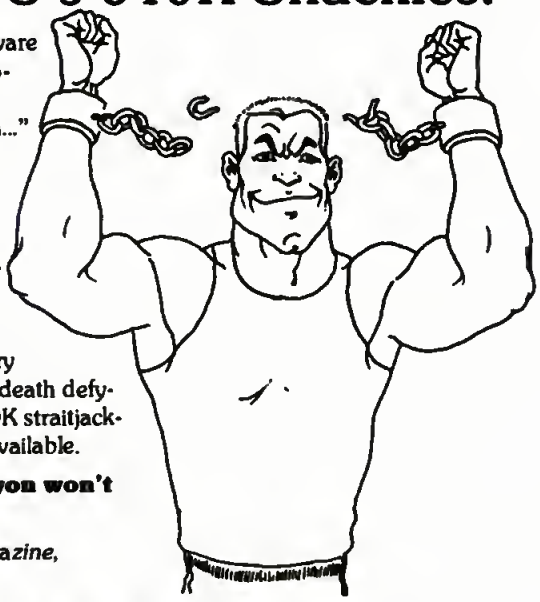

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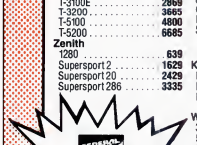

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CIRCLE 205 ON READER SERVICE CARD

Stephen Manes

CD-ROM visionaries keep insisting the medium will change the world. A teen dream from Japan suggests they may well be right—in ways that might give them nightmares.

The future of CD-ROM is not a goody-two-shoes interactive algebra program that transmogrifies cretins into Einsteins. It is not a giant hypertext database of the world's philosophical navel-gazings. It is not a universe of data at your fingertips. I have seen the future of CD-ROM, and it is a date with Noriko.

Who is Noriko? She's been described as "Japan's Tiffany"—as in singer, not jeweler. Her ardent fans helped make NEC's $200 CD-ROM player the most popular in the world.

A $200 CD-ROM player? When a cheap CD-ROM player costs three times that much on the street? What gives?

For openers, it's slow. The specs say the average access time is 3 seconds. Grim, given that the .8-second access of a typical PC-market CD-ROM drive seems glacial.

The drive mates only with a dedicated NEC game machine called the PC Engine and requires a special interface unit that costs about as much as the drive itself. It accepts only proprietary-format CD-ROMs, not the standard High Sierra/ISO 9660 models (though a modification for them should be simple).

But it does play standard CD audio disks and display the CD-G graphics embedded in many of them—a trick that otherwise requires a fairly expensive decoder. So Japanese Christmas shoppers snapped up 100,000 of the units, despite a library of only three available CD-ROM disks: an audiovisual database of some 500 bizarre cartoon characters heretofore found only on candy wrappers; a kick-boxing game called *Fighting Street*, complete with realistic CD-audio grunts and thuds; and the unforgettable Ms. Noriko.

MANDATORY SWOON SONG

Whereas Tiffany purveys modern teen angst to other girls, Noriko's worshipers are pubescent males. According to the kind NEC folks who walked me through her disk—my Japanese ends at "Sapporo Dry"—the plot begins with you, randy teen guy, finding Noriko's personal diary. To return it to her requires that you attend her concert, and I do mean *requires:* there's no way to avoid or escape from her exquisitely vapid low-res music video.

Which was why my guide terminated the demonstration and told me the rest. After the concert, Noriko's manager discovers that her date for the evening is mysteriously indisposed: Would you be so kind as to escort the star for an evening in Tokyo?

BOY TOY FOR A NIGHT

You would. You take her shopping, go out for dinner, visit a mud-wrestling establishment, buy an illicit Macintosh clone, the usual teen fun. When you take Noriko home, a cloudburst *ex machina* forces Noriko to modestly ask you in. Together you play such exciting games as "rock, paper, scissors" until you seethe with frustration, at which point, with exquisite politeness, she boots you out the door—perhaps the most realistic computer-game denouement ever.

Noriko is quite possibly one of the worst computer games ever, because the implementation is wildly inferior to the idea. But transplant this thing to the United States, swap Jon Bon Jovi for Noriko, and you've got something amazing: the first exciting interactive entertainment (fancy for video game) for girls. Release a dozen titles, and machines will whisk off the shelves as mall princesses vie to collect the whole set. Investment tip: Snap up CD-ROM rights to teen heartthrobs now.

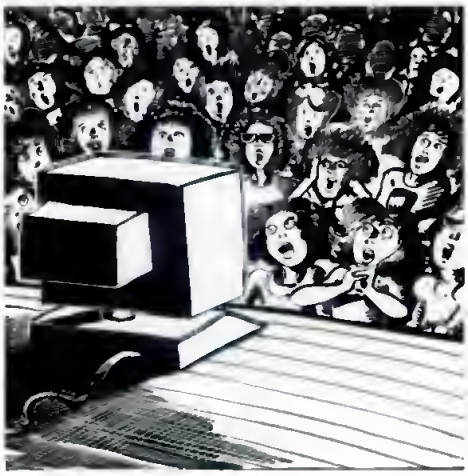

ILLUSTRATION: TOM LULEVITCH

As this year's Microsoft CD-ROM conference made clear, Microsoft, IBM, and Intel certainly believe CD-ROM software is going to

Stephen Manes

be important someday—too important to abandon mass-market applications to the forthcoming no-computer-needed CD-I players. For the first time ever, IBM has announced a commitment to CD-ROM, including the CD-ROM XA standard, which makes it relatively easy to sync sounds with images to produce, as Sony did, a jazzy interactive catalog of products: click on the boom box, and it blasts you senseless.

IBM is joining Intel in the development of DVI (Digital Video Interface)—a standard that promises TV-quality full-screen, full-motion video from any MS-DOS computer with a decent monitor and a free slot. Down the road, say 1991, you may not even need that free slot if the DVI chip set shrinks and IBM puts it on the motherboard to support a CD-ROM drive in every machine it ships. Unlikely? Fujitsu is already making a major splash in Japan with its FM TOWNS machine, an expensive, IBM-incompatible PC that just happens to have a CD-ROM drive built in.

Bill Gates reeled off a laundry list of ideas for future CD-ROM applications, including programs that actually teach themselves and publicly available databases of heretofore in-house-only support documentation. But Lotus is leading the way. Its new Prompt service offers by subscription an extensive collection of product information that includes demonstration versions, new drivers, and support documentation. At $995 a year, it's not exactly cheap, but it does include a whole mess of press releases.

And for the *Lotus 1-2-3*, Release 3.0, rollout, Lotus has produced a rather dazzling interactive demo with CD-quality audio and realistic (albeit not full-motion) color video. Put yourself in the shoes of a sporting goods wholesaler with just half an hour to prepare a bid for a customer. Pick the wrong formulas and you have to stall the customer when he calls back. Pick the right ones and you get the order. If it's not the best demo/training disk ever, it's certainly the best-looking—the difference between GUI (Graphical User Interface) and VUI (Video User Interface).

Even the less gee-whiz aspects of CD-ROM offer benefits, as Cinemaware demonstrated with a CD-ROM edition of its *Defender of the Crown* game. The simple addition of CD-ROM–based narration, music, and dialogue make the experience seem far more like a movie than the relatively low-res adventure game it is. A jaunty background tune makes waiting for a program to load code almost tolerable. Which leads us to note in passing that the sound capabilities of the basic PC are in woeful need of improvement.

KNOW YOUR AUDIENCE

Ultimately, you don't really care how you get raw data, and it's probably cheaper online than on CD. An "everything you never knew you wanted to know about *Guernica*" disk developed by commercial ace Robert Abel may seem noble, but its potential market is the coffee-table book set. A "find out more about Mozart" disk may have its heart in the right place, but it's about as mass-market as haute couture.

No, the product that drives CD-ROM will have the content of network TV—or maybe its commercials. The "killer app" might just be an extension of what brought VCRs into American homes. Interactive pornography, anyone? ■

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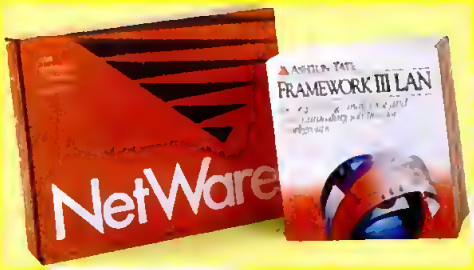

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286 LAPTOPS Compute en Route

CONSTRUCTED ILLUSTRATION: JAMES NAZZ

by Bill Howard

They're losing weight, coming down in price, and lasting longer away from your AC outlet, but these seven 286 laptops still have a bit of streamlining to undergo before they'll fulfill every item on your wish list.

When your DOS-to-travel needs call for more than just the electronic notepad and e-mail-fetching tasks that can be handled by entry-level laptops, you may well be in the market for an 80286-based portable. A 15-pound 286 laptop provides more performance and storage than an 8088/8086 machine, without causing the sticker-price shock that you'll feel when you go one tier higher and shop for an 80386-based portable.

But make no mistake: 286 portables are cheaper, not cheap. Compared with desktop PCs, you're paying a healthy premium to fit all that power into one third of a cubic foot: $3,000 to $4,000 (street price) for the performance equivalent of a $1,500–$2,000 desktop PC.

In this issue, we review seven 80286-powered portables from Compaq, GRiD, Hewlett-Packard, Intelligent Technology, Mitsuba, Toshiba, and Zenith, and we overview NEC's almost-complete ProSpeed 286. They all provide battery power, which is essential for truly portable PCs. While the vast majority of your work occurs near 120-volt outlets, there will be times when you desperately need

to finish a report at 37,000 feet, or in the back of a cab, or in an airport waiting lounge. And that makes battery power nearly mandatory in any portable. If you disagree, Compaq, Dolch, Sharp, and Mitsubishi, among others, will gladly sell you tether-cord computing.

RAPID CHANGES

The competitors are roughly the same, but their lineups have changed since *PC Magazine*'s last comparison review of portable PCs. (See "Take It or Leave It: Portables with Desktop Power," *PC Magazine*, October 11, 1988, for a comparison of 12 286- and 386-based portables and transportables.) Every major vendor except Zenith has announced a new 286 portable, and Compaq has joined the battery-powered, truly portable market. Here's what you'll find today in your better 286 laptop:

■ **VGA and EGA displays.** Of the eight machines, (including the NEC ProSpeed 286) three provide VGA (640 by 480) and two offer EGA (640 by 350) displays, all about 10 inches diagonal (8 by 6 inches). And it's about time, given that the EGA standard is nearly 5 years old, and VGA is 2½. Last fall, only 2 of the 12 portables reviewed even offered EGA. There's a noticeable superiority over the CGA screens, especially in graphics modes. That's important, because these machines are often pressed into service as portable demo machines and hooked to VGA and EGA monitors at demo sites. In 1989, you can't run an impressive demo at CGA's 320 by 200 pixels. All displays are illuminated, of course; all are black-and-white; and all drive external color monitors.

■ **Hard disks standard.** Most 286 portables offer 20- and 40MB drives with reasonably fast average-access times, unlike early 286 portables such as the first Toshiba T3100s with 10MB, 150-millisecond drives. The floppy drives are 1.44MB rather than the 720K ones found on 8088/8086 laptops. With the exception of the GRiDCase 1520, you couldn't buy a two-floppy 286 machine even if you wanted to.

■ **Modestly improved battery life.** PC Labs found that these machines provide 45 minutes to 3 hours of real-world computing. Compaq is out front on power-conservation techniques; it has a standby mode that lets you walk away from the machine for several days without losing a byte.

■ **Few size-and-weight improvements.** These machines run 15 to 17 pounds with battery pack and charger, not much different from the Zenith SupersPort 286 that was last year's 286-to-beat. One exception to the trend: the special-purpose ITC 286 CAT. It's 19 pounds and noticeably bulky—but it's the only machine in the group with a cellular modem and phone built in. And, yes, it does work.

■ **Adequate speed.** All have 12-MHz 80C286 processors, except for the GRiDCase 1520, which has a 10-MHz chip and the NEC ProSpeed, with a 16-MHz processor. Ten to twelve MHz may be nothing special when desktop PCs run as high as 33 MHz, but it's enough to keep most graphical applications moving comfortably.

The price of power? Expect to pay from $3,000 to $3,500 (street price) for the ma-

THE PERFECT PORTABLE (REVISITED)

by Bill Howard

Two years ago, we predicted the ideal laptop of the future: 4.5 pounds, 12 by 8 by 2¼ inches, a 4.77/9.54-MHz 80C86 or equivalent processor, a megabyte of nonvolatile RAMdisk instead of a floppy disk drive, and programs burned into ROM ("Road Warriors: 11 Laptops Battle It Out," *PC Magazine*, July 21, 1987). Apart from the price (which I underprojected by 50 percent), that's exactly what NEC introduced a year and a half later in the form of the $3,000 UltraLite.

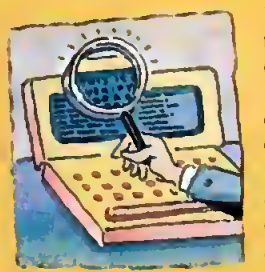
Among the portables you can buy today, the features are still what set the best apart from the merely adequate—more than raw performance does. What good is blazing CPU speed if you can't read the screen?

Here's a checklist of the features to look for (or look out for) in a portable PC. Most points apply to anything from an 8088 laptop to a 20-MHz 80386 luggable, and for the most part the features are here today. Unfortunately, not all on the same machine.

INTELLIGENT POWER-DOWN

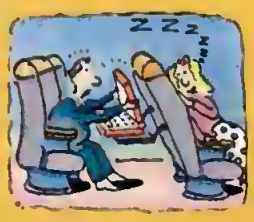
When the display, hard disk, keyboard, modem, and printer port aren't in use, each one should temporarily deactivate itself. Many portables provide power-down, but some step you through an involved process to change one setting, then force a reboot to activate the feature. Compaq's standby mode lets you suspend work for days on end without draining the battery.

READABLE SCREEN



VGA LCD controllers provide 640 by 480 resolution and discernibly different gray shades. EGA is a passable second choice. Don't settle for anything less on a 286 or 386 portable. CGA LCDs are adequate for text (many provide 640 by 400 double-scan), but they revert to 640 by 200 in graphics mode. Ugh! The right size for a laptop screen is somewhere in the neighborhood of 8 by 6 inches. Some of the 8088/8086 laptops on the market today shrink their displays to save money. Worst offenders: Toshiba's nonilluminated T1000 (3½ inches tall) and IBM's now-deceased PC Convertible.

CENTER-HINGED SCREEN



Some people really use laptops on planes. If the screen is hinged closer to the center (Zenith, Hewlett-Packard) or if it's a short unit to begin with (Compaq), those few inches let you work in steerage class when the guy in front reclines his seat.

DETACHABLE KEYBOARD

Among the laptop models reviewed here, only the Compaq has a removable keyboard. It's wonderful. Too bad it lacks the complete set of cursor keys.

NONSTANDARD CONNECTORS

Each laptop vendor has its own rules for connectors. NEC's internal modem won't fit in a Toshiba, and Compaq's expansion connector doesn't look much like Zenith's. Third parties are beginning to make machine-specific accessories, especially modems and LAN cards, which should spell the

ILLUSTRATIONS: GARY ZAMCHICK

chines with 20MB disks, $500 more for the 40MB versions, and a bit more still for the Compaq. You can get bigger hard disks on 386 portables, but generally not on 286s (GRiD and NEC, however, offer 100MB drives). In comparison, 8088/8086 laptops with 20MB hard disks cost about $2,000 to $2,200, or $1,500 with dual floppy drives. If you ascend to a 386 portable, you'll pay about $5,000 for a system with a 16-MHz processor and a 40MB hard disk.

DOCKING STATIONS

With all that power on tap, a portable could be the only PC you need to buy. Docking stations and expansion chassis provide some of the expansion capabilities your portable may be lacking: 8- and 16-bit expansion slots, room for another hard disk drive, possibly a floppy disk drive or tape backup unit, and your network or 3270 connection. At least that's the theory. In practice, most of the expansion units will disappoint you. They're overpriced underperformers.

Take Toshiba's $999 expansion chassis. Please. All five slots are 8-bit (XT style), and one slot belongs to a mandatory $199 interface card. This is the same unit that Toshiba has been trying to sell to T1100 Plus owners for over 2 years now. Zenith's $499 expansion chassis, which works with the similar HP portable, has three 8-bit slots. Compaq's $999 docking station provides two 16-bit slots, I/O ports, and snap-in connections, but it's vaporware: announced with the SLT last October, shipping dates still aren't firm. NEC's $899 expansion station sounds like the best bet: one 8-bit and three 16-bit slots, a half-height drive bay, and "intelligent configuration," meaning that when it's connected, an alternate boot-up configuration takes over that recognizes an external monitor as well as additional drives and memory.

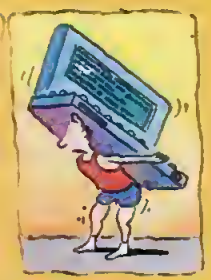
In defense of what seems at first blush to be sheer ineptitude and lack of market savvy, the design of expansion boxes requires sophisticated engineering to resolve timing problems and FCC emissions concerns, because the data bus is far longer than on your PC. In a broader sense, these engineering challenges explain why you haven't seen laptops released by every maker of affordable PC compatibles: it's darn hard work, and as machines become smaller, the design becomes a challenge for both electrical and mechanical engineering.

To enhance your portable's usefulness back in the office, you also can buy separate numeric keypads ($60 to $150), 101-key keyboards, and external 5¼-inch floppy disk drives. But should you? If your purpose is to recreate the amenities of a desktop PC, maybe you should just buy a desktop PC. A reliable 12-MHz AT-compatible with graphics monitor and hard disk costs as little as $1,400. If all you need is some way to connect a network adapter, Mitsuba, NEC, and Toshiba provide proprietary internal slots; they or third parties will offer Ethernet, Token-Ring and ARCnet cards. Each company's proprietary slot is unique, but the slot is often the same within a company's line of portables, such as NEC's LTX slot. As befits its end of the $600 vendor modem (from Compaq, GRiD Systems, and NEC).

QUICK-DISCONNECT BATTERIES

If you really don't need your battery on the next trip, you can detach it and save 2 to 4 pounds. Nearly all 286 portables have slide-in or clip-on modules now. Gluttons for punishment can carry extras. NEC's space-saving AC transformer can replace the battery brick. In case you work out of your car, several laptops have optional 12-volt adapters.

WEIGHT AND SIZE



Read vendor specs with a cautious eye. They're wont to omit the weight of the battery and AC adapter—in one instance, even though the comparison sheet includes all this weight for competitors' models. The true weight of a portable PC is the system unit plus battery pack plus transformer plus carrying case. Look for lighter 286 portables by year's end (under 10 pounds with battery).

BATTERY GAUGE

Wouldn't it be nice to know how much battery life you have left before the low-battery alarm sounds? Hewlett-Packard used to have a real gauge on its old flying-wedge Vectra laptop (different from HP's reworked version of the Zenith SupersPort). The next best thing is Traveling Software's Battery Watch program. HP and Toshiba provide software-based battery gauges.

EXPANSION UNITS

Why do you need one? Not for extra memory, 40MB hard disks, or EGA/VGA video cards, since the best portables have those features now. Some laptops even have room for a network adapter. Expansion boxes cost so much that you can almost buy a cheap AT clone for the price. Once vendors get more realistic (with under-$500 prices and 16- rather than 8-bit slots), consider buying one if you're networked.

OVERSIZE CARRYING CASES

With the airlines' two-carry-on-bag limit, your laptop case has to double as your briefcase. To date, we've seen precious few cases with enough room for file folders, printouts, reading glasses, a calculator, a newspaper, a Robert Ludlum novel, and your portable's huge operations manual (since most vendors don't provide a 12-page summary booklet).

COMPLETE CURSOR-KEY SET

With keyboard space at a premium, some portables forgo dedicated Home, End, PgUp, and PgDn keys. Instead, they force you to hit a separate Fn (function) key and one of the arrow keys. Toshiba, NEC, Mitsuba, and ITC found space for all eight keys.

bulk, ITC has room inside for a true AT-bus 16-bit expansion card. Most battery-powered portables don't have slots because the power supply has to be made bulkier and heavier to handle the extra power draw of a card.

Don't give up on the concept of expansion units and docking stations just because today's choices are less than thrilling. As PCs become smaller, there's no reason you shouldn't be able to put the heart of the system in one box with a handle and the rest in an expansion module.

REVIEW CRITERIA

For this review of portable PCs, we chose 286 portables because, as of spring 1989, they constitute the most changing, vibrant segment of the market. The battery-powered-386 market is trying to figure out a coherent statement of purpose: Are we heavy, powerful portables, or are we desktop PCs that happen to have handles and batteries? The 8088/86 market will heat up shortly with ultralight portables, but all the players haven't arrived yet. To be included in this review, a portable had to have:

- an 80C286 processor (C stands for CMOS, the low-power version of the 286)
- battery *and* AC power
- an illuminated screen
- a high-density, 1.44MB floppy disk drive
- a 20MB or larger hard disk
- 2MB memory capacity or better
- weight under 20 pounds—the upper limit of portability.

For this review, we chose battery-powered 286 portables because, as of spring 1989, they constitute the most changing, vibrant segment of the market.

Common to all machines are clamshell designs, with the displays in their hinged tops. Compaq's is a modified clamshell with detachable keyboard. All have room for an internal 1,200- or 2400-bit-per-second modem, serial and parallel ports, and a connection for an external color monitor.

The battery-ability criterion excluded the Dataworld Portacomp II, Dolch P.A.C. 286, Mitsubishi MP286L, Ogivar 286, Sharp PC-7221, the Toshiba 3000 series, and Compaq Portables II and III, most of which we reviewed in last October's roundup of high-powered portables. Since last fall, there also has been a steady influx of Compaq Portable III knockoffs from the Far East, with cases designed such that if the Portable III were built by Lotus or Apple, there'd be yet another "Look and Feel" lawsuit.

A couple of other portables on the horizon will fit the criteria when they ship. The Sharp PC 5541, announced last fall, will have a 40MB hard disk, VGA display, and $5,595 list price. Olivetti's M211, announced in April and due in the third quarter of 1989, has an EGA display, 40MB hard disk, and $5,499 list price.

5-POUND 286?

Short term, you'll see more of the same: VGA replacing CGA, a few ounces saved here, half an inch there, slightly longer battery life. Far bigger changes are on the horizon. They'll take two forms: the same power in a smaller unit, or more power and storage in the same size. Within a year, you should see at least two vendors providing 80286 variants of NEC's UltraLite, a 4.4-pound 8086-level notebook computer with a 2MB "silicon disk" that won a *PC Magazine* 1988 Award for Technical Excellence.

For mass storage, choices include silicon disks, 2½-inch floppy drives, and 2½-inch hard drives. PrairieTek produces a 20MB hard disk drive that weighs just 8 ounces and draws 3 watts; Rodime, Conner Peripherals, MiniScribe, and JVC are said to be close behind, and PrairieTek is talking about a 40MB version by year's end. Such a machine might weigh 6 to 7 pounds initially; the cost would restrict it to the top of the corporate food chain at first. But the same technology could help the current crop of portables shed a pound or two and retain their comparatively affordable prices. By year's end, you should see a 286 portable that weighs under 10 pounds with batteries.

Color portables may well arrive this year. But will they be power-user tools or novelties? Color LCD displays draw more power because you have to force the backlight through three color layers, instead of just one. And the first-generation color schemes may not be as well balanced as CRT colors. They'll be expensive, of course. Hitachi, IBM, NEC, Sharp, Toshiba, and Zenith have shown prototypes.

You'll also see 80386SX-based portables arrive this year, both as downscale 80386 machines (bulky, likely to be AC only) and as upscale 286 portables (compact, battery option). The arrival of these machines has been hastened by Intel's April 11 announcement of a very-low-power 80386SX chip.

NEW TESTS

Frequent contributor Bruce Brown and PC Labs ran each unit through a series of benchmark tests, including a new battery-life test designed to reflect real-world usage. We deep-discharge (important for nickel cadmium batteries) and fully recharge the battery, then run a test that keeps the keyboard, display and CPU engaged (to circumvent inactivity power-downs) and writes to disk a time-stamp file of about 15K (14,965 bytes) once per minute. Screen illumination accounts for the largest amount of power drain, followed by the hard drive and system electronics, so a test that lets the screen go dim isn't real-world.

As is our tradition with portables, we also take them on road trips and expose them to a fair number of the nation's air terminals, coach-class tray tables, and hotel phone systems, to provide real-world insight for the reviews and counterpoints.

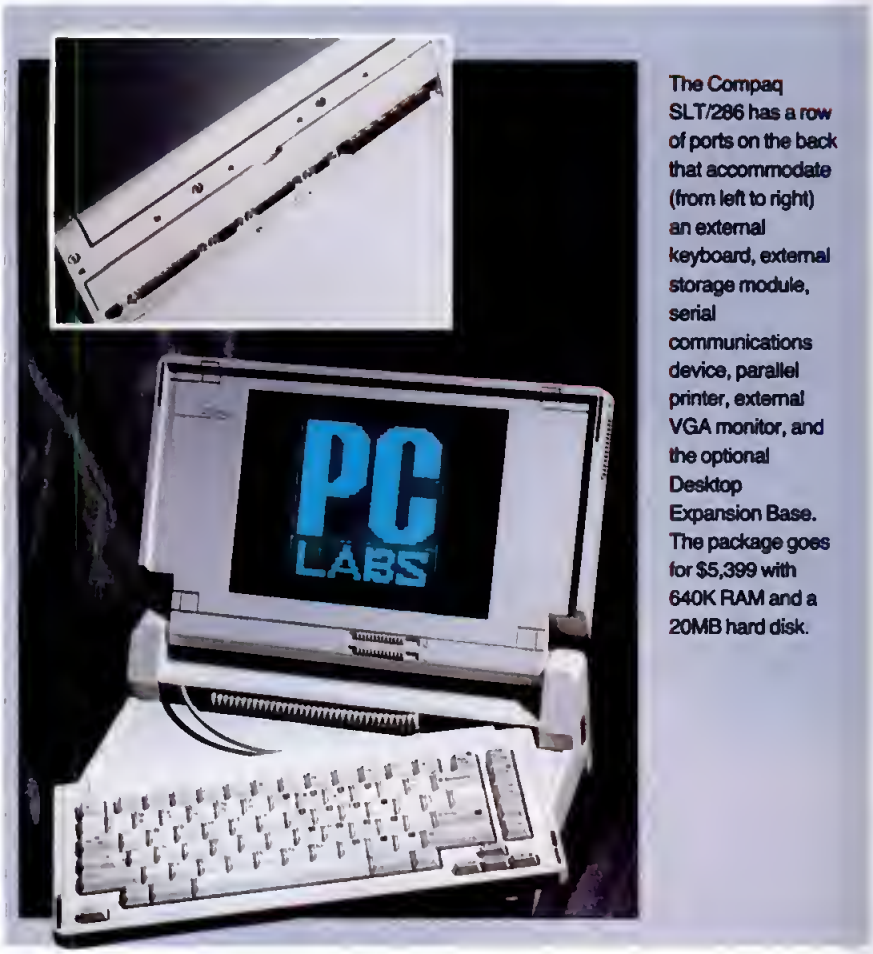
Bill Howard is an executive editor of PC Magazine.

COMPAQ COMPUTER CORP.

Compaq SLT/286

All reviews by Bruce Brown

We waited a long time for this machine, but the wait was worth it. When Compaq designed the SLT/286, it did just about everything right, and even better, the company priced it on a par with its competitors. The VGA screen is a knockout and combined with its various other merits—very good to excellent benchmark-test performance, intelligent battery conservation, a raft of expansion possibilities, and top-flight case and component design—it makes Compaq's long-awaited laptop an obvious winner both on the road and quite



The Compaq SLT/286 has a row of ports on the back that accommodate (from left to right) an external keyboard, external storage module, serial communications device, parallel printer, external VGA monitor, and the optional Desktop Expansion Base. The package goes for $5,399 with 640K RAM and a 20MB hard disk.

possibly on your desk as well.

The basic Compaq SLT/286 Model 20 uses a 12-MHz 80C286 processor and comes with 640K of one-wait-state RAM, one 1.44MB 3½-inch floppy disk drive, a 20MB 29-millisecond hard disk, one port each for parallel and serial devices, and an external VGA monitor port all for $5,399, not including DOS. The Model 40 with a 40MB hard disk also rated at 29 ms. lists for $5,999. The $8,316 test machine was a Model 40 with 2 extra megabytes of extended memory at $799 per megabyte, a $599 internal 2,400-bits-per-second modem, and DOS 3.3, a $120 option. DOS 4.0 is available for $150, and OS/2 1.1 (the Presentation Manager version) costs $340.

The SLT/286 weighs 14 pounds with battery and measures 4 by 13½ by 8½ inches (HWD), taller than most other laptops but also much less deep—convenient for shallow workspaces such as airline seat-back trays. If you carry the 1¾-pound AC power supply in a case with printer and modem cables and a few floppy disks, it's easy to top 17 pounds: a fairly significant, if not crippling, weight.

The first thing you notice when you fire up the SLT/286 is its screen. The display's technology is VGA backlit supertwist LCD, but those terms don't convey its impact. The background is slightly marbled gray and the foreground characters are off-white. With its 640 by 480 resolution, the screen is clear, sharp, and rich-looking. It's also fast, achieving the best times of this group of machines on the video benchmark tests.

MOBILE KEYBOARD

With the screen raised, the SLT/286's 82-key keyboard sits directly on top of the rest of the unit. You can use the keyboard where it is or pull it off, moving it onto your lap or a desk or table surface—anywhere its 2-foot coiled cable will allow it to reach. When it's removed, you can use the hinged feet at the rear of the keyboard to get a good typing angle. The responsive keyboard has a slight click and reasonable travel but lacks the admirable snappy feel of the Toshiba T1600 keyboard.

The keyboard has 12 function keys running horizontally across the top of the other keys and an embedded numeric keypad using 15 keys on the right half of the keyboard. To use the embedded keypad, you have to hold down a small key marked *Fn* in the lower-left corner of the keyboard. The cursor control keys are arranged in an inverted-T configuration on the lower-right section of the keyboard. Home, End, PgUp, and PgDn don't have keys of their own but are activated by using the cursor control keys with the Fn key. In general the arrangement is convenient and workable. For $249 you can buy an optional external, full-size keyboard, a good idea if you intend to use the SLT/286 as a desktop.

The SLT/286's internal nickel cadmium battery is assisted by two power conservation techniques, component shutdown and standby mode, both of which are activated when you are using battery power. Standby is user activated; it puts the computer on hold, saving the current memory contents but shutting off the display, drives, keyboard, CPU, and modem. When you are ready to start work again, just push a special Standby key and everything comes back on. Component shutdown automatically monitors your use of separate parts of the computer, turning off the display, drives, keyboard, CPU, and memory if you don't use them for a user-defined time period.

Compaq claims a battery life of greater than 3 hours without a charge, which is realistic. In our battery run-down test, the SLT/286 lasted almost 3 hours. Recharging takes only 1½ to 3 hours, much faster than the competition. Extra batteries cost $129 and weigh just under 2 pounds. If

PC MAGAZINE FACT FILE
EDITOR'S CHOICE

Compaq SLT/286
Compaq Computer Corp., 20555 SH 249, Houston, TX 77269-2000; (713) 370-0670.
List Price: With 640K RAM, 20MB hard disk, 1.44MB 3½-inch floppy disk drive, $5,399; with 40MB hard disk, $5,999; with 2.6MB RAM, 2,400-bps modem, DOS 3.3, $8,319. 1MB RAM upgrade, $799; Expansion Base, $999; carrying case, $89; DOS 3.3, $120.
In Short: Compaq's pacesetting 12-MHz 286 laptop combines a terrific VGA-compatible screen, a decent keyboard, practical battery performance, and loads of expansion capabilities in a 14-pound package. It's truly an innovator and it's priced competitively to boot.

CIRCLE 413 ON READER SERVICE CARD

PHOTOGRAPHY: THOM O'CONNOR

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Introducing the laptop computer

Problems, problems, problems.

Computers were designed to solve them.

But sometimes they've been known to cause a few of their own.

Example: You just purchased a laptop. At first, everything seems fine. But soon you want to expand your data base. Use more sophisticated software. Link-up to local area networks. When you realize you can't, you begin to ask yourself:

Where's the power?

Where's the expandability?

Where's the receipt?

Introducing an end to all your problems. The ProSpeed™ 286, from NEC.

Weighing under 15 lbs., the ProSpeed 286 is surprisingly light.

But in other areas, it's a real heavyweight. In fact, it offers the full functionality of a high-performance desktop.

The ProSpeed comes equipped with one megabyte of memory that's expandable to five.

And, it comes with either 20 or 40 megabyte hard disk drives.

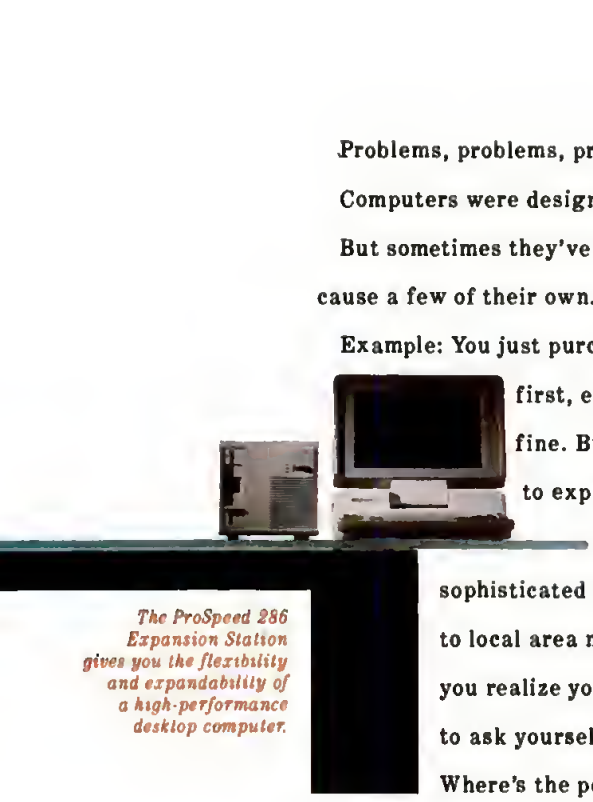
There's even an advanced model that provides a high-speed 100 megabyte drive for special applications.

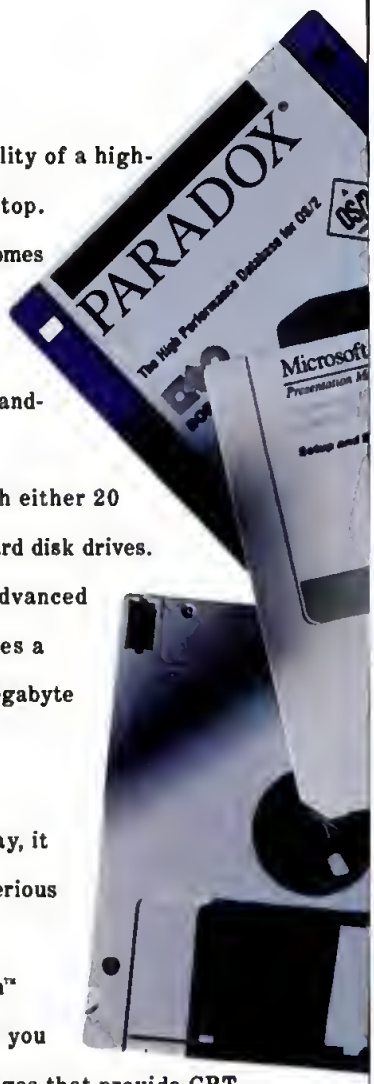
As for its display, it clears up a very serious problem: clarity.

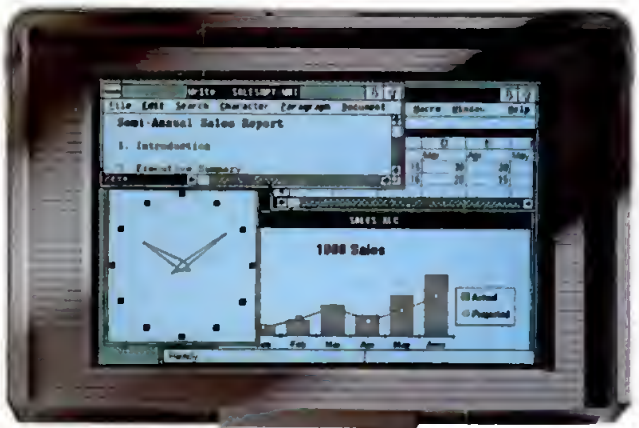
NEC's Monograph™ CTN screen gives you crisp, backlit images that provide CRT quality with VGA resolution.

For power-hungry executives, the ProSpeed 286 is powered by

The ProSpeed 286 Expansion Station gives you the flexibility and expandability of a high-performance desktop computer.







The ProSpeed 286 VGA screen is so clear and crisp you can even display multiple windows.

that solves problems others can't.

The ProSpeed 286 runs at 16MHz. It's the fastest 80286 laptop around.

a CMOS 80286 processor running at 16MHz.

Meaning it's fully capable of handling the most demanding DOS applications.

Not to mention OS/2 Presentation Manager and Windows.

And then there's the ever-expanding problem of expansion, for which NEC has developed a unique solution called an Expansion Station.™ It's an innovative system that includes four standard slots, one standard drive bay, a power supply and permanent connections for both printer and serial devices.

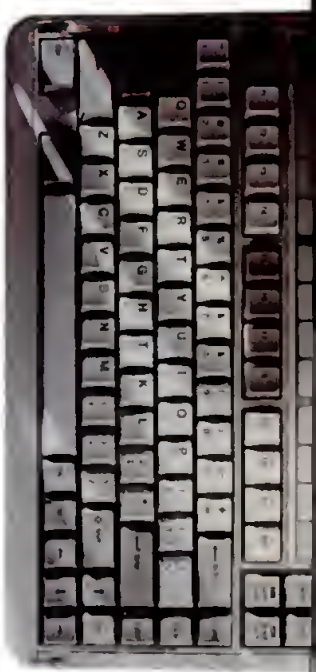
Admittedly, there's one problem we can't solve. Whether to use the ProSpeed 286 as a laptop or desktop?

That's one you'll just have to tackle yourself.

Call 1-800-826-2255 for literature and 1-800-FONE-NEC for technical advice. In Canada, call 1-800-268-3997.

ProSpeed™ 286

The ProSpeed 286 features a full-function keyboard with standard spacing.



NEC

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CIRCLE 258 ON READER SERVICE CARD

COUNTERPOINT

by Bill Machrone

The **Mitsuba Ninja-12**, as tested, bore no identifying marks or labels. It has a good keyboard: the travel is full, but quiet. The layout is a little idiosyncratic: I never got used to the location of the backslash key. The black-and-white LCD screen is just OK, with some hot spotting. Like the Zenith, the screen hinges let you lay the screen back completely. Overall, this machine's solid feeling and smooth lines make it a comfortable machine to use.

GRiD machines still have that industrial-strength quality about them. The gas-plasma display of the **GRiDCase 1520** still jumps out at you, bold orange on jet black, but takes a back seat to backlit LCD displays. The flatness of the keyboard is an ergonomic quirk dating from the earliest GRiD designs, but the feel is quiet and silky. The unvented case gets a bit warm, but nothing like the old egg-frying GRiDs.

The **Compaq SLT/286** is an amazingly good blend of size and power. The removable keyboard is a plus for many users, but the case should have some indentations to hold it securely atop the machine when it's in its raised position. The touch is light and silky, perhaps the best I've ever encountered on a portable. It's a relative disadvantage that you need the Fn key to get at functions such as PgUp and PgDn, but if it's your only machine, you'll retrain yourself quickly. The fluorescent backlight tubes are plainly visible behind the display, which caused Compaq to ship the machine in a less-attractive white-on-black default mode. Closed, the SLT looks like a child's attache case, a pleasing and different configuration.

Differences in details supposedly set Hewlett-Packard's OEM'd Zenith SupersPort apart from the Zenith. They're invisible to me. Like that of its twin, the **HP Vectra LS/12** display takes some fiddling with the contrast and brightness controls. It blurs horizontally and vertically, typical of the last-generation screen-control chips. But the big, almost-square display is easy to read. The Zenith/HP has the best overall ergonomics in this class. A great package that's very easy to live with.

The generous screen size and bright display of the **Toshiba T1600** are offset by an ugly font, like that found on other Toshiba portables. The keyboard is the noisiest in the group, but the layout is decent. I love the dual batteries and wish the cover didn't have to be humpbacked. The lack of a built-in handle makes a machine in this weight class unwieldy. Overall, however, it's a very desirable machine. ■

Bill Machrone is editor-in-chief and publisher of PC Magazine.

you travel and carry one additional battery you can get up to 6 hours of battery operation a day and then at your hotel recharge one battery in the evening and the other overnight.

No expansion slots come standard, but a $999 Expansion Base option that serves as a docking station for the SLT/286 offers slot capability. In addition to two 8/16-bit expansion slots for full-size interface cards, the Expansion Base includes duplicate parallel, serial, external video, and keyboard plugs. If you have the Expansion Base set up in your office with a full-size VGA monitor and a keyboard attached, you can just slide the SLT/286 into the Expansion Base and be ready to go, without spending time attaching and detaching cables. The Expansion Base is a great idea for people who want to use the same computer in the office, on the road, and at home; however, the Expansion Base had not yet shipped when we tested the SLT/286. Compaq also sells external 5¼-inch 1.2MB and 360K floppy disk drives, a 40MB hard disk drive, and a 40MB tape drive, each with its own power supply. You can plug one external drive into a dedicated port on the back of the computer.

USEFUL UTILITIES

While MS-DOS is not standard, the SLT/286 comes with several useful utility programs including an Extended Memory Manager, a RAMdisk program, Compaq's Disk Cache program, power-conservation and setup software, and a screen-saving program.

The SLT/286 is as expensive as a desktop AT with a VGA screen, but its pricing is in line with other vendors' battery-operated laptop machines. The screen is the best currently on the market, and its intelligent battery use and quick recharging help the SLT stand out. This may be the first laptop that's good enough to use full time as a desktop machine, if you're very tight on desk space. But if you have more room and want to add an Expansion Base (as soon as they're available) with a color VGA monitor and a full-size keyboard, the SLT/286 still makes sense as a desktop machine for portability-minded buyers. Otherwise, if you're just shopping for a laptop and want to spoil yourself with the best screen you can buy, go Compaq.

GRiD SYSTEMS CORP.

GRiDCase 1520

You can't tell a laptop by its case. The GRiDCase 1520 is possibly the best-looking computer in the bunch, with an elegant black magnesium case. The screen looks like a winner as well, with bright characters against a black background. Unfortunately the GRiD's awkward keyboard, large character set, hot-running power supply, and high price keep it from winning any honors except for appearance.

GRiD Systems Corp., which was purchased by Tandy Corp. in 1988, has long been considered the premier laptop vendor. The company still makes good hardware, but if it is going to be competitive with the likes of Compaq and NEC, GRiD needs to introduce newer models.

The GRiDCase 1520 uses a 10-MHz 80C286 that can also be set back to 6 MHz if your software requires it. (Its sibling GRiDCase 1530 uses an 80C386 processor.) One megabyte of one-wait-state RAM is standard. Increasing RAM to a total of 2MB costs $595, and a 4MB system is $2,395 extra. The base model 1520, with two 1.44MB 3½-inch floppy disk drives and a yellow backlit LCD display costs $3,495. The test machine had one floppy disk drive and a bunch of expensive options—a $1,175 20MB hard disk; a $995 gas plasma screen option; a $90 internal, removable, rechargeable nickel cadmium battery; and GRiD's special version of MS-DOS 3.3, a $150 option—for a total price of $5,905.

All GRiD screen displays have a maximum resolution of 640 by 480, with CGA compatibility. A 9-pin RGB port on the

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The keyboard of the GRiDCase 1520 is narrow and lacks dedicated cursor-movement keys, but the worst feature is a large Fn key located on the right side of the keyboard. It should be on the left so that it can be used more conveniently as a Shift key for the embedded numeric keypad. The machine costs $3,495 with 1MB of RAM.

back lets you hook up an external CGA monitor, though the CGA's relatively rough character set definitely seems old tech compared with more modern EGA and VGA monitors. The test machine's gas plasma screen has reddish-orange characters on a hlack background. The contrast level is very high, and the characters are clearly visihle from all angles. The screen is very readable, even if the character set is coarse.

KEYS TOO CLOSE

The GRiDCase's 72-key keyboard is not much fun to use. The keys are responsive enough and feel solid, but they're too close together. The width of the area actually used by the keys is only 10¼ inches, a full ¾ inch shorter than the next wider keyboards on the Zenith and Hewlett-Packard offerings—with laptops even fractions of an inch matter. I have only medium-size hands, but found the GRiDCase's arrangement cramping. The narrow width is helped neither by the keyboard's unusual flatness nor by the awkward key arrangement.

A numeric keypad makes douhle use of the letter keys on the right side of the keyboard, a common practice, with a special function (Fn) key to implement the keypad use. Unfortunately the Fn key is on the bottom-right side of the keyboard rather than on the left side, which is more common. In order to use the numeric keypad, you have to hold down the Fn key with your right thumb and hit the other keys with the fingers of the same hand. You can use both hands, but that's even worse. To add to the difficulty, the PgUp, PgDn, Home, and End keys all require the Fn key as well.

An internal slot open to the back of the GRiDCase can hold either the rechargeahle nickel cadmium battery or the AC power supply/battery charger. With the hattery in place, the power supply is plugged into the back of the battery and runs the computer and recharges the battery. GRiD estimates that you get 30 to 90 minutes running time with a fully charged battery, which corresponds with the 41-minute results we obtained in our battery run-down tests. Charging a spent battery takes between 10 and 12 hours.

RUNNING HOT

Instead of plugging the AC power supply into the back of the battery, you can run the GRiDCase with the power supply inside the computer. This works out fine as long as you don't hold it on your lap—if you do, watch out, because the power supply puts out too much heat for lap use. If you use the machine only on a desk, you won't care about this problem, and if you hold the machine in your lap only with the battery installed, it won't matter either. Of course, trying to remember when and how not to get toasted hy the bottom of your laptop rather negates its whole purpose.

The GRiDCase is fairly deep at 15.1 inches, but it is only 11.5 inches wide and 2.3 inches high. With a battery, the GRiDCase 1520 weighs 11½ pounds, the least of the machines reviewed in this batch. A serial port, a parallel port, and ports for an external drive and keyboard are also included. The GRiDCase has no capacity for adding expansion cards, but there are two sockets for optional ROM chips that can hold DOS or application or custom software.

PC MAGAZINE FACT FILE

GRIDCase 1520
GRiD Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94538; (800) 222-GRID.
List Price: With 1MB RAM, two 1.44MB 3½-inch floppy disk drives, backlit LCD screen, $3,495; with 20MB hard disk, one 1.44MB 3½-inch floppy disk drive, gas plasma screen, battery pack, DOS 3.3, $5,905. 1MB RAM upgrade, $595; 40MB hard disk, $1,675; 100MB hard disk, $2,895; battery pack, $90; carrying case, $60; DOS 3.3, $150.
In Short: The GRiDCase 1520 is ready for an update. The 10-MHz 286 has a bright screen but only CGA resolution—way behind the times. It has a cramped keyboard with an awkward design, and its power supply, runs very hot.

CIRCLE 414 ON READER SERVICE CARD

GRiD Systems sells a number of options for this machine, including an automohile/boat power adapter, an internal 2,400-hps modem, a high-speed serial card, the JT-Fax Portable Fax, an acoustic modem coupler, a numeric keypad, external 1.44MB 3½-inch and 360K 5¼-inch floppy disk drives, and a 40MB tape backup unit.

If you buy the GRiDCase with MS-DOS you get several special utilities, including battery-power-conservation software that turns off the power to the hard disk drive and screen if they're inactive, as well as a set of programs called PCMAS-

By using ordinary phone lines, Carbon Copy Plus lets your PC gain complete control of a remote PC. So two users can share the same keyboards, disks, screens and application programs. And if you're sharing a graphics program, it's not a problem. Because Carbon Copy Plus connects more incompatible graphics standards than anyone else.

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CIRCLE 731 ON READER SERVICE CARD

COUNTERPOINT

by Bill Howard

Technology marches forward so quickly that the quality and desirability of these 286 portables proves almost inversely proportional to their ages.

Sleek design takes the aging **GRiDCase 1520** just so far. The only thing that draws more power than a plasma display like GRiD's is a short circuit; contrast is superb, but the scratchy character set is rough even by CGA standards. The flattish, 9/10 scale keyboard will throw off your typing rhythm. GRiD's best feature remains the two extra ROM sockets: a corporation can create custom apps, burn them into ROMs, and have them load instantly.

Last year, the **Zenith SupersPort 286** was a runner-up for our Technical Excellence award. The basic design remains technically excellent, but the once-wondrous CGA screen is no longer the brightest, crispest, or biggest. It needs a VGA transplant right away. The same comments apply to the essentially identical **HP Vectra LS/12,** which adds a few pieces of software to the package.

It's time somebody put a cellular modem (and phone) in a portable PC. Even making allowances for the extra circuitry, the **ITC 286 CAT** is too darn bulky. Maybe it should be called the ITC 286 Garfield. Both should diet.

The **Compaq SLT/286** is the class of the field. You'll love the detachable keyboard, controlled powerdown of unused peripherals, and the standby mode that lets you wander off for a week, then pick up right where you left off. To my eye, the SLT's VGA display is better in graphics than in text mode; the Mitsuba, NEC, and Toshiba displays were roughly equal to that of the SLT, and a NEC ProSpeed 386 that happened to be handy was better than all of them. The incomplete set of cursor keys annoys me no end (the same applies to Zenith, HP and GRiD) and I wish you didn't have to pay $999 for the docking station just to add a network connection. But until something better comes along, Compaq is worth the $300 to $400 price premium.

The **Toshiba T1600** is an all-around solid performer, and a bit lighter than the average. Toshiba's manuals on-disk (plus slender paper versions for the road) should be mandatory on all laptops. Toshiba shouldn't have compromised on an EGA screen, and so far you can buy only a 20MB hard disk. The $1,200 expansion box (fits XT cards only) shows the Japanese have a sense of humor.

The word *Mitsuba* doesn't roll easily off the tongue, but don't let that stop you from considering the **Mitsuba Ninja-12.** A most impressive machine, and reasonably priced. Since the screen is capable of double-scan CGA (640 by 400), at the very least, the Ninja could have had EGA graphics, too.

Another magazine gave the NEC **ProSpeed 286** its version of Editor's Choice in an issue produced in February. We'll defer final judgment till the ProSpeed ships (it was slated for May). Based on what we saw of a nearly complete unit (only the final case color was in flux), this 16-MHz speed demon could be Compaq's main competition. The expansion box is the only one of the bunch that makes sense, and the slide-in battery and AC modules are the best solution we've yet seen to dealing with bulky AC adapters.

My personal checklist says: don't buy any machine that lacks VGA and eight dedicated cursor keys. Even though it fails the second test, I'd go with the Compaq and the 40MB drive. Second choice: NEC, then Toshiba. ■

TER and PCSLAVE, which let you hook the GRiDCase up directly to another computer via a serial null-modem cable for easy file transfer.

The GRiDCase 1520 was an exciting computer a year and a half ago, but the competition is much stiffer now. While you might pick up a few unwelcome pounds with competing machines, you'll get higher-resolution screens, better keyboards, and faster processors for less money. The GRiDCase 1520 wins on weight and has the most handsome case, but otherwise the best I can say is that I'm looking forward to testing GRiD's upcoming series of machines.

HEWLETT-PACKARD CO.

HP Vectra LS/12

Hewlett-Packard does many things very well, but it had problems coming out with an acceptable laptop computer. The HP Vectra LS/12 is the result of a smart move on Hewlett-Packard's part: the company uses the basic hardware of the popular Zenith SupersPort 286 and relabels this admirable box as the HP Vectra LS/12.

Except for the coloring of the keyboard markings, the LS/12's hardware is exactly the same as the SupersPort's. Hewlett-Packard uses its own ROM chips, however, and distributes its own software.

The base-model Vectra LS/12 is a 6- and 12-MHz 80C286-based zero-wait-state 1MB-RAM laptop that weighs 14½ pounds with a battery and lists for $4,879, $120 less than the Zenith version. A 40MB version costs $5,479, and an extra 1MB of RAM, which takes the machine to its 2MB maximum, costs $799.

The HP Vectra LS/12 is the result of a smart move on Hewlett-Packard's part: the company relabels the basic hardware of the popular Zenith SupersPort 286.

The Vectra LS/12's supertwist backlit LCD screen is easy to read, with blue letters on a light gray screen. The 640 by 400 maximum resolution isn't EGA, but double-scan CGA compatible. Many people won't notice or even care about the difference, because this high-contrast, bright screen is very readable, a key factor with laptops.

JUST LIKE ZENITH

The keyboard is also just like the Zenith's, with 80 keys, an embedded numeric keypad, and an Fn key on the left side to use

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CIRCLE 195 ON READER SERVICE CARD

Basically the same machine as the Zenith SupersPort 286, the HP Vectra LS/12 sells for $4,879 with 1MB of RAM and a 20MB hard disk. This laptop comes standard with *Battery Watch*, a convenient RAM-resident program that monitors the battery level.

with the keypad and for the Home, End, PgUp, and PgDn keys. The keyboard action and feel are very good, preferred by some to the Toshiba keyboard.

Ports on the back of the machine include single serial and parallel ports, a port for an external floppy disk drive, and an expansion bus for a separately available $499 three-slot 8-bit expansion chassis. There's also a connector for an optional $129 numeric keypad and a 9-pin RGB port for an external CGA monitor.

The Vectra LS/12 measures 3 1/10 by 12 1/5 by 12 1/5 inches (HWD). The 4 1/2-pound detachable nickel cadmium battery contributes a good part of the 14 1/2-pound weight, but the payback is an excellent battery running time of almost 4 hours on our battery run-down test; Hewlett-Packard claims 3 to 4 hours. Recharging takes 12 hours with the computer on and 8 hours if the computer isn't running but is plugged into an AC outlet. No car battery adapter is available.

One advantage the LS/12 has over its Zenith twin is a pop-up TSR program called *Battery Watch*, which tells you how much time you have left to use the battery. You can also use this program to completely discharge the nickel cadmium battery, an important benefit since these batteries suffer from something called "battery effect." If you don't let a nickel cadmium battery discharge completely before recharging, it won't run as long later. It's not good to use a nickel cadmium battery just for a short time and then "top off" the battery, so to speak. If you're only on battery power for a little while you should either detach the battery before using AC power or wait till the battery runs down before hooking up to normal power. *Battery Watch* saves you from the irksome aggravation of playing nursemaid to your battery and lets you completely discharge the nickel cadmium whenever you want so that you can get it back to full charge. Every battery-operated laptop should have *Battery Watch* (also available separately from Traveling Software) or its equivalent. It's laudable for HP to include it with the laptop.

Other standard Vectra LS/12 software includes MS-DOS 3.3, GW-BASIC, a Hewlett-Packard terminal program, and a Hewlett-Packard disk-caching program as well as an HP specific Set-Up program that differs from Zenith's ill-named Monitor program. The last piece of standard software is a LIM-EMS 4.0–compatible memory management program.

Like the Zenith, the Vectra LS/12 scores in the upper-to-middle range on benchmark tests, although the hard disk drive is on the slow side when you're not running the disk-caching software.

The Vectra LS/12 is a competitively priced unit that uses the extensive Hewlett-Packard service and support network. HP made a good choice in using the Zenith hardware to round out its growing line of computers with a battery-operated 286 laptop. This machine is a good choice today, but some current machines have equal or better screens, and tomorrow's laptops will be even more competitive.

PC MAGAZINE FACT FILE

HP Vectra LS/12
Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; (800) 752-0900, (408) 720-3000.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3½-inch floppy disk drive, DOS 3.3, $4,879; with 40MB hard disk, $5,479; with 2MB RAM, 2,400-bps modem, $6,727. 1MB RAM upgrade, $799; carrying case $99.
In Short: The 12-MHz HP Vectra LS/12 is hardware-equivalent to the popular Zenith SupersPort 286. The LS/12 adds different software including a battery monitor, a terminal program, and different setup utilities. The biggest news is that HP sells this unit $120 cheaper than Zenith, and a 1MB RAM upgrade is $500 less. The HP's screen, keyboard, and performance all rate well, and its battery life tops off at almost 4 hours.

CIRCLE 415 ON READER SERVICE CARD

INTELLIGENCE TECHNOLOGY CORP.

ITC 286 CAT

Finally, the ultimate beach computer! The ITC 286 CAT is a battery-operated 286 computer that includes both a cellular telephone and an error-correcting cellular modem so that you can work on a spreadsheet and send it off to your office while sitting in the sand with the waves tickling your toes.

Practically speaking, you probably won't want to risk getting sand on this $7,595, 19-pound computer, let alone salt water. And you can only expect an hour or so at most before its nonremovable battery runs down, even after it's fully charged.

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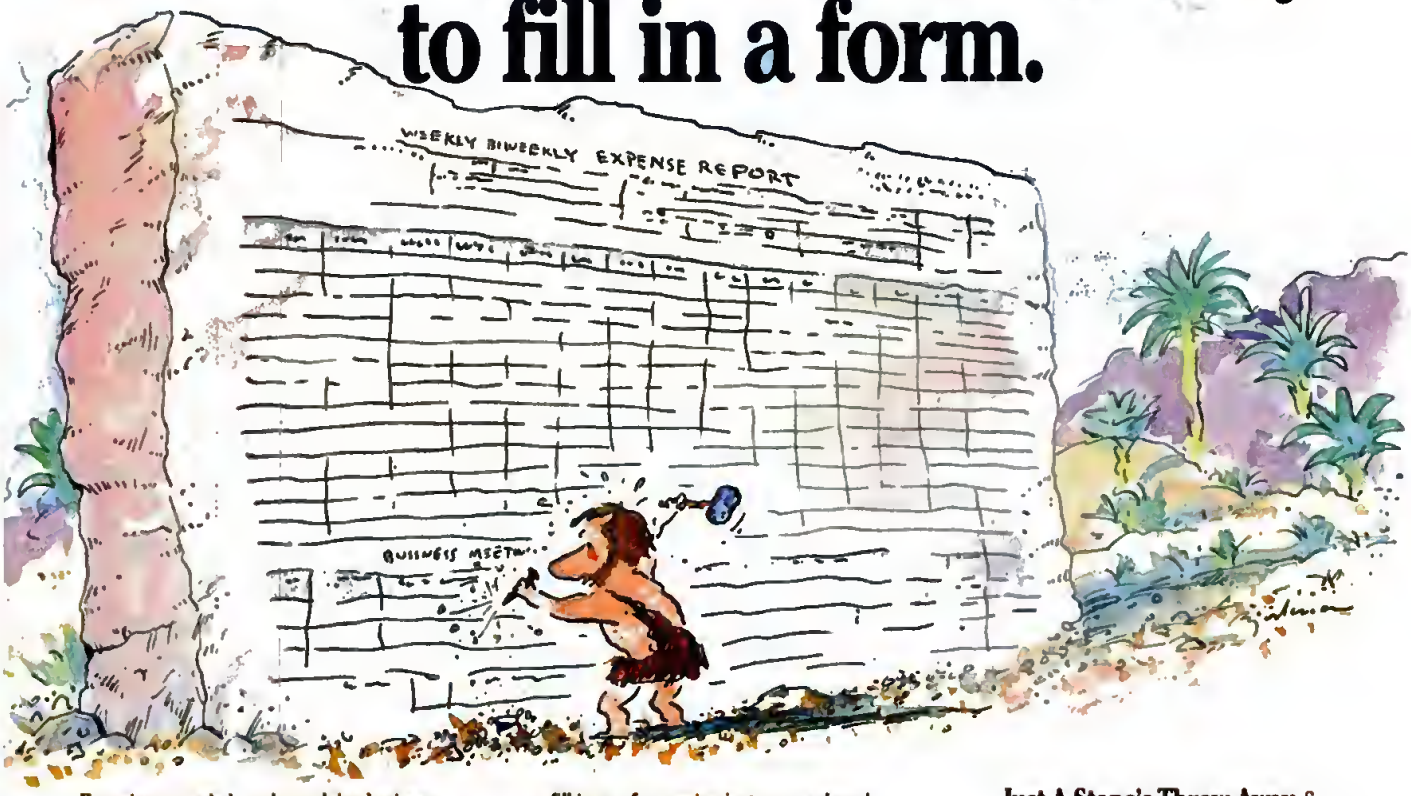

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CIRCLE 174 ON READER SERVICE CARD

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HEWLETT PACKARD

CIRCLE 372 ON READER SERVICE CARD

DIET FOR A 286-BASED BATTERY-OPERATED LAPTOP

by Stephanie K. Losee

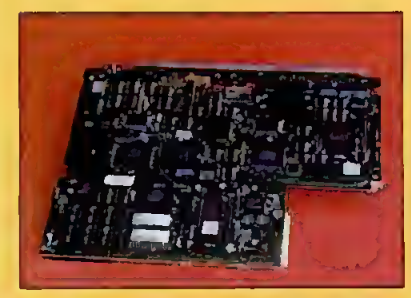
The Zenith SupersPort 286 has just about everything you could ever want in a laptop—from sleek design to long battery life. But although it's one of the smallest 286 laptops around, it still feels more luggable than light; at 14½ pounds with battery pack, the SupersPort is heavy enough to make any zealous computer user wish he were still using a pencil. At *PC Magazine* we've made a lot of noise about laptop weight, so it's time to talk about where we think the ounces can come off. We took Heath's Zenith SupersPort 286 laptop kit—an unassembled machine you put together yourself—and weighed the components separately to determine the source of each pound. (Strangely enough, the total weight of the components is 15.63 pounds, over a pound more than the weight of a SupersPort 286 bought fully assembled.) Next to each component you'll find an assessment of where laptop makers could shave off a few ounces, as well as indications about what type of superlight materials future laptops may be made from.

List Price: With 1MB RAM, 1.44MB 3½-inch floppy disk drive, DOS 3.3, $2,999. 20MB hard disk, $679; 40MB hard disk, $799. Heath Co. (a subsidiary of Zenith Electronics Corp.), Benton Harbor, MI 49022; (800) 253-0570.

CIRCLE 420 ON READER SERVICE CARD

If your arm has recently lengthened from the strain of carrying around a too-heavy portable computer, take heart—there's more than one way for a 286 laptop to lose weight.

SYSTEM BOARD: 1.22 POUNDS



By using a greater degree of very-large-scale integrated (VLSI) components and packing them closer together, Zenith could make the system board somewhat less cumbersome.

KEYBOARD: 0.96 POUNDS

Using lightweight materials could shave a few ounces off the keyboard, but at the expense of reliability and quality—perhaps too high a price. The keyboard can't be made smaller without cramping typing style, and making it lighter may cause it to feel unsubstantial, making long-term laptop use far less pleasant.

FLOPPY DISK DRIVE: 0.92 POUNDS

Improvements in floppy disk drives are already on the horizon as companies develop 2½-inch media. Miniaturizing both the drive and the disks could make quite a dent in the overall weight and size of 286 laptops.

Recharging takes about 4 hours, so continuous use away from a source of AC power isn't practical with the ITC.

EXECUTIVE PERQUISITE

Even though the ITC will run on a battery, that's not its primary use and not what makes it special. Everything about this machine murmurs "executive," and that's probably its primary market—people who need and can afford a convenient combination of portable computer and telephone components. At 19 pounds, the 4- by 15⅔- by 14½-inch (HWD) computer isn't light, but its large keyboard, good-size hard disk drive, and complement of features provide full power in a portable unit.

When you buy an ITC you don't have to decide which screen or drive to get, there's only one choice; and everything but a $700 2MB memory upgrade is standard. The ITC runs on an 80C286 12-MHz processor that can also be slowed to 6 MHz for picky software. The standard 640K RAM runs with zero wait states. Also standard are a 1.44MB 3½-inch floppy disk drive; a 40MB hard disk; an EGA-compatible backlit supertwist electroluminescent LCD screen; one parallel and one serial port; and ports for external tape or floppy

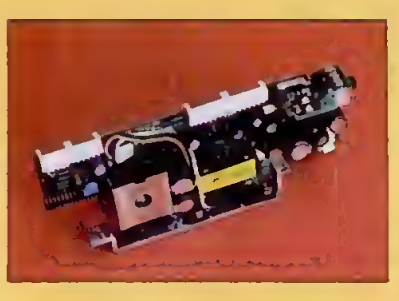
BATTERY: 4.52 POUNDS

Here's where the trade-offs come in. At 4½ pounds, the SupersPort's battery runs for an impressive 3 hours and 50 minutes. It could easily be cut down to size and inserted into the machine as a rechargeable battery pack (such as that used to run the Compaq SLT/286), but battery life would be reduced proportionately. If you don't always need 4 hours of battery power, carrying a massive battery around is a nuisance; still, swapping battery packs and recharging them constantly isn't much fun either.

CASE: 3.87 POUNDS

Here's where a lot of headway can be made. Use of high-strength, injection-molded plastics or lightweight materials such as Kevlar could reduce the weight of the laptop's shell drastically. And of course, the smaller the laptop's components, the smaller the case can be, thus shaving off even more pounds.

POWER TRANSFORMER: 0.54 POUNDS

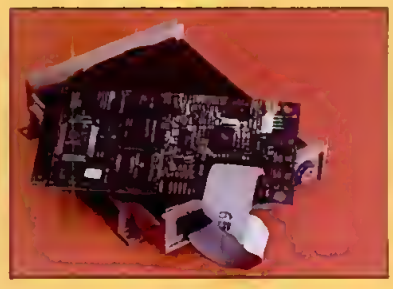


The power transformer charges the battery and allows the system to run on an AC adapter when the battery is not in use. As semiconductor technology becomes more sophisticated, transformers will become smaller—although the Zenith unit is already very compact.

BACKLIT LCD SCREEN: 1.15 POUNDS

The most obvious way to lighten up a screen is to make it smaller, but as laptop screen technology improves, users are clamoring for larger—not smaller—screens. Removing the backlight would eliminate a few ounces—but at the cost of your patience and eyesight it may be too much to ask. If reducing the weight and size of other components necessitates the use of a smaller screen, however, the trade-off may be worth it.

20MB HARD DISK: 1.47 POUNDS



Like floppy disk drives, hard disks will benefit tremendously from the introduction of smaller media, such as PrairieTek's 2½-inch hard disk. Another place to cut corners is in the construction of the hard disk's case: using lightweight, high-strength alloys would reduce weight still further.

CONNECTING HARDWARE AND CABLES: 0.98 POUNDS

Potential improvements in connecting hardware may drive the price of laptops abominably high. All screws and brackets, for instance, could be constructed with titanium alloys. Toroid coils, which cut down on radio frequency emissions (thus helping the machine to meet FCC standards), could also be made of lightweight alloys. But because these materials could double the price of the laptop, it's not likely that we'll see them in the near future.

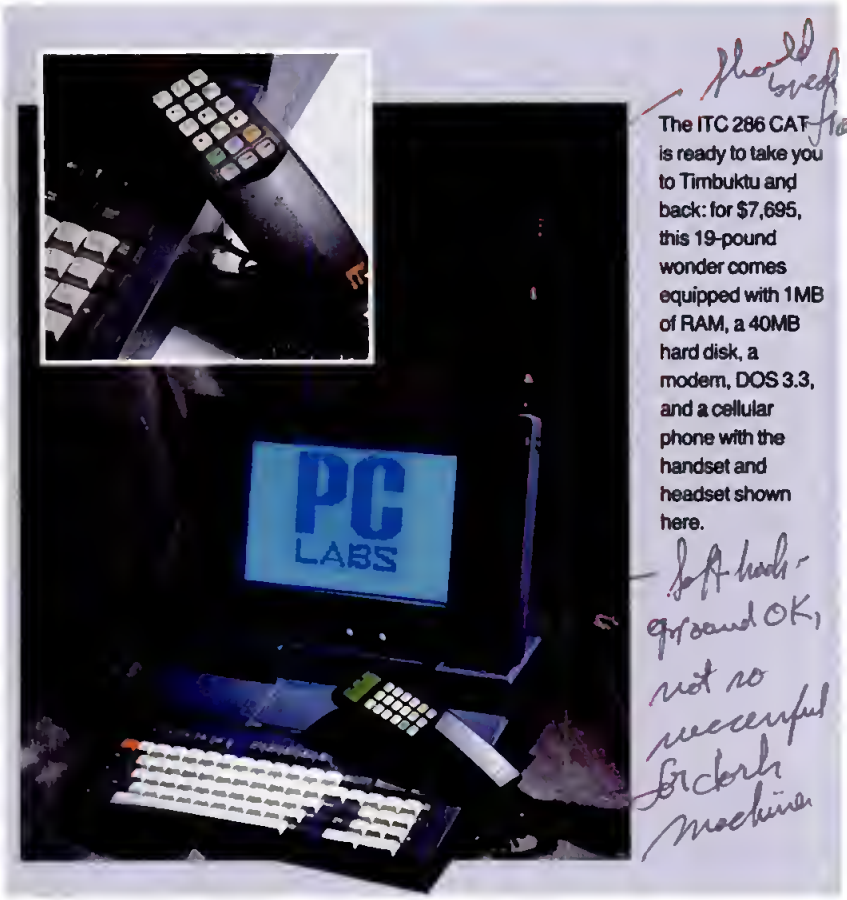
drives and for an external monitor.

That's it for the normal components, but the ITC also comes with a built-in cellular speakerphone that can be run from the keyboard or a handset included with the system. Other standard items include a car/boat power adapter, a carrying case, MS-DOS 3.3, and *Mirror II* (communications software).

The proprietary motherboard uses Phoenix 80286 ROM BIOS, Version 3.10, and includes one full-length AT-compatible expansion slot, which is where you'd put the optional 2MB memory board or perhaps a network adapter, but not both. At present there is no external expansion option to allow you to use more than one card. There is a socket for an 80C287 math coprocessor chip, but if you want one you'll have to purchase it elsewhere, because ITC doesn't currently sell them.

The ITC 286 CAT performed well on the PC Labs benchmark tests, with middling but certainly acceptable scores.

The ITC's display is pretty good, though you may find yourself fooling with the brightness and contrast controls until you get it just the way you want it. The screen is EGA compatible, with a maximum resolution of 640 by 400, and the



The ITC 286 CAT is ready to take you to Timbuktu and back: for $7,695, this 19-pound wonder comes equipped with 1MB of RAM, a 40MB hard disk, a modem, DOS 3.3, and a cellular phone with the handset and headset shown here.

video adapter supports CGA, MDA, and EGA display modes. If you don't use the keyboard for 5 minutes, the screen backlighting turns off until you touch a key again, at which time it instantly turns back on. If you use the ITC in one location for very long, you'll probably want to purchase a full-size external EGA monitor, for the extra measure of visual comfort.

AMPLE KEYBOARD

The first impression of the ITC's keyboard is that it's large for a laptop, reminiscent of keyboards of the early 1980s, and closer to typewriter keyboards than most current PC keyboards. The keyboard is a full 14 inches wide, 2½ inches wider than the next widest unit on the Toshiba T1600. With a single exception, the key arrangement works well, with ten function keys in a horizontal row at the keyboard's top. The one off-note is the CapsLock key, a large key that is just to the right of the Spacebar, where it's easy to hit by accident. Otherwise the ITC's keyboard is fitting for its intended users, probably people who don't want to compromise with a more cramped, computerish keyboard.

In addition to the external video port, there are also one serial and one parallel port, an RJ-11 telephone jack, and a port for an external floppy disk or tape drive. There's also a system-reset button on the back of the machine as well as separate power switches for the computer and the cellular telephone.

You can use the cellular phone simply from the keyboard and talk through the computer's integral speakerphone, but I found it more convenient to attach and use the standard handset. The cellular handset has its own laundry list of features, including 100-phone-number memory, one-key dialing, a call-in-absence indicator, last number redial, electronic locking, battery meter, and air-time meter as well as many other telephone use and performance functions and indicators.

I'm not a cellular-phone devotee—in fact, this was the first time I've used one—but without resorting to the manual, I was able to place calls. In the equipment-laden PC Labs I used ITC's cellular phone, on battery power, to call Connecticut, Pennsylvania, California, and even to make a lunch reservation in Manhattan, so we know it's usable for the important functions of business life. The handset cannot be used with normal plug-in phone lines, although the speakerphone can save cellular phone fees when normal telephone service is available (you can dial out using the keyboard).

The internal cellular modem can be used either with the internal cellular phone line or with a conventional telephone line (called a land line in cellular phone parlance, the same term the CB folks use). The dual-mode error-correction modem has circuitry to detect and correct both the normal signal noise and fade problems associated with all modem use, as well as signal loss and error-detection and retransmission problems specific to cellular phone use. No telephone data transmission scheme is perfect, especially with normal voice lines rather than dedicated telephone lines, but this system should work well for you wherever normal or cellular telephone service is available.

PC MAGAZINE FACT FILE

ITC 286 CAT
Intelligence Technology Corp., 16526 Westgrove Dr., Dallas, TX 75248; (214) 250-4277.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3½-inch floppy disk drive, cellular phone with handset and headset, cellular modem, battery, car/boat power adapter, carrying case, $7,695. 2MB RAM upgrade, $700.
In Short: This 19-pound portable is on the heavy side for a laptop and runs for less than an hour on battery power alone, but it includes everything for the cellular-phone-mad, computer-savvy businessperson. A good combination of components if you need them all, but heavy and pricey if you don't.

CIRCLE 416 ON READER SERVICE CARD

If you don't have the handset plugged in, no one would know about the ITC's cellular phone capabilities unless they noticed the top of the antenna. The retractable, internal, high-gain antenna is the Rubber Duck style, which means it's rubber coated and fairly short and stubby (only 7 inches long fully extended). All your James Bond fantasies can be sparked by sitting in a corner seat of a commuter train, opening the ITC, extending the antenna and then talking into the handset in a subdued voice, even if you just call up the time or weather number.

The ITC's relatively short battery life, large size, relatively high weight, and hef-

Now there's a battery-powered 286 with the one feature you've been waiting for.

That little package you've been expecting from us has just arrived.

The new Toshiba T1600. The fastest battery-powered portable computer we've ever made.

It packs a powerful 12MHz 286 microprocessor. One full megabyte of RAM that's expandable to 5MB. Plus a fast 20MB hard disk.

Equally impressive is its 1.44MB 3½ inch diskette drive, detachable, backlit EGA-compatible display and two expansion slots for access to an internal modem, LANs, mainframes and much more.

But at a total weight of under 12 pounds, the T1600 is bound to spend a lot of time *outside* the office. Which is why we added some other important features.

Like AutoResume, which lets you restart your work wherever you finished. And space for two removable, rechargeable battery packs no larger than the palm of your hand.

All of which makes one thing about the T1600 unmistakably clear.

It was definitely worth the wait.

T1600: Battery-powered 80C286/12MHz, 20MB hard disk at 27msec, 1.44MB 3½" diskette drive, 1MB RAM expandable to 5MB, detachable backlit EGA-compatible LCD, removeable rechargeable battery pack, coprocessor socket, 7 standard interfaces, 2 expansion slots for general purpose options. For information call 1-800-457-7777. Toshiba PCs are backed by the Exceptional Care Program (enrollment required).

In Touch with Tomorrow

TOSHIBA

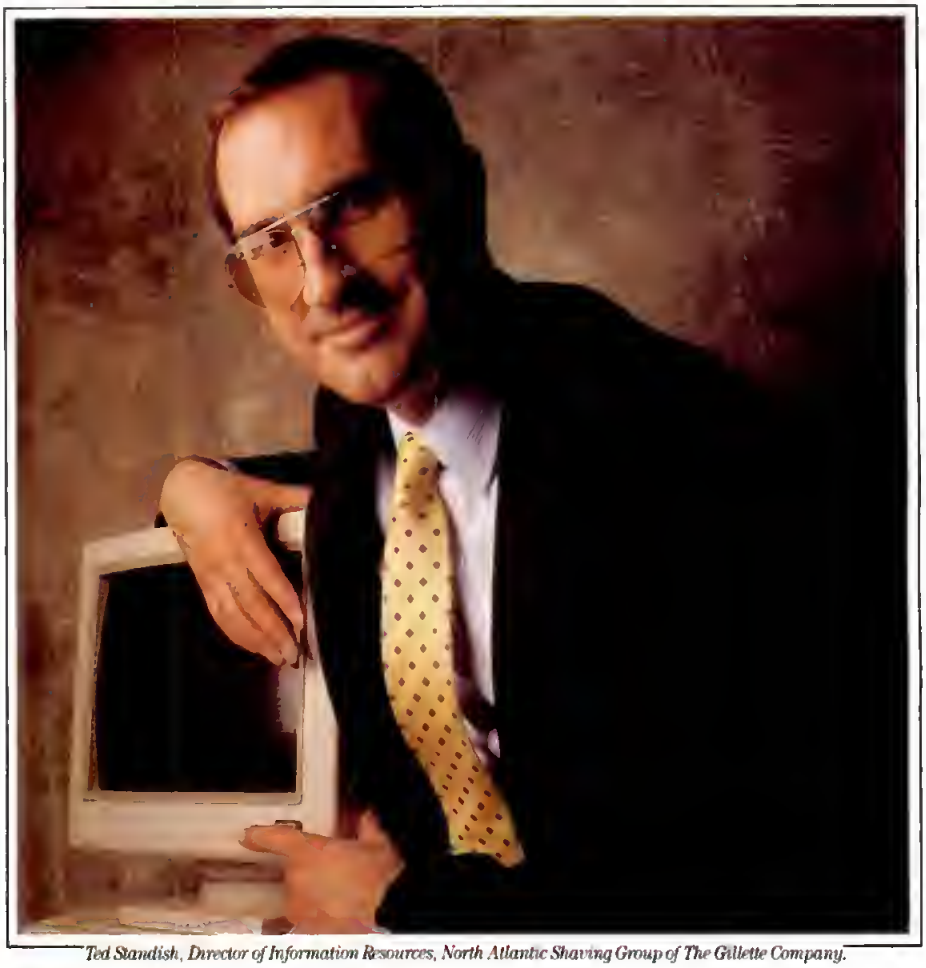
Toshiba America Information Systems, Inc., Computer Systems Division

CIRCLE 321 ON READER SERVICE CARD

Ted Standish has a bear of a job.

As Director of Information Resources for the North Atlantic Shaving Group of The Gillette Company, he's been given the task of simplifying and standardizing the business systems of the Company's European and North American divisions.

"With the coming of the European open market in 1992, we want to take a more unified approach to products, as well as to manufacturing and marketing," says Ted.



Ted Standish, Director of Information Resources, North Atlantic Shaving Group of The Gillette Company.

"Before Lotus Agenda, there were three things I always forgot. Tasks I assigned, promises I made, and I can't remember the third."

"This means dealing with hundreds of issues, projects, facts and people throughout the North Atlantic region every day.

"As you might imagine, reams of little pieces of paper with notes, phone numbers, ideas and who-knows-what-else were beginning to take over my office."

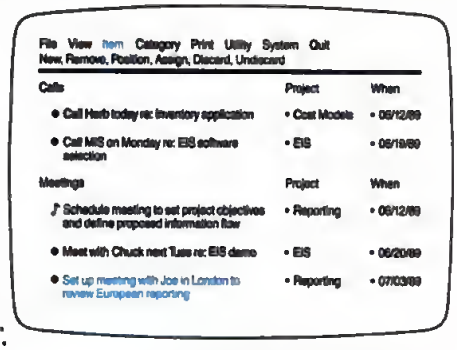
Which is why Ted visited his local computer software reseller and bought Lotus® Agenda,® the personal information manager.

In Agenda, Ted has a tool that's helping him manage people, projects, ideas, plans and information, all with incredible efficiency.

Because Agenda allows him to enter

Agenda is also available in an OS/2® version. If for any reason you're unsatisfied with Agenda, return it with your sales slip within 30 days of purchase and we'll refund your full purchase price.

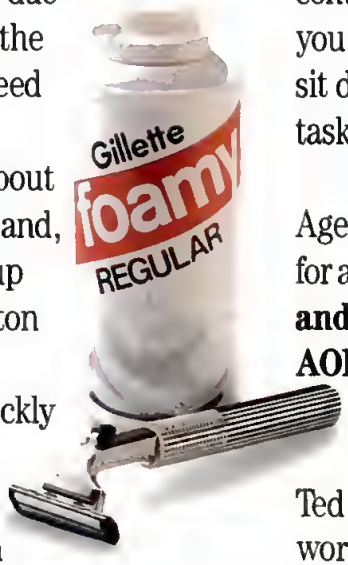
information into his PC without having to structure it in advance. Agenda automatically arranges the data any way Ted wants so he can understand it better, formulate new ideas better and extract the answers he needs better.



The new Agenda Activities Planner gives you step-by-step instructions that put you in control of your information quickly

"It lets me focus more on using my information and less on processing it," says Ted.

"For example, I can dump in all my 'to do's' and have Agenda organize, prioritize and categorize them automatically. And whenever I call up a project, person or due date, I'm instantly given all the background information I need to make smart decisions.



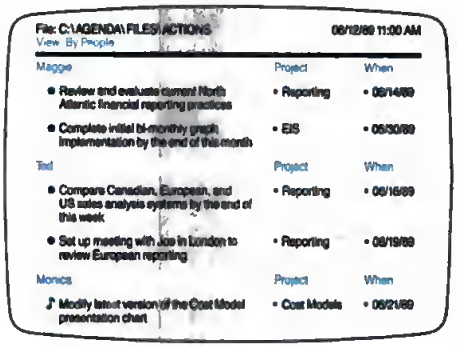
"Now I no longer worry about what I told someone in England, or what somebody else set up in France, or who's in Boston doing whatever.

"Agenda allows me to quickly consolidate all these things in a single place. And discover relationships between people and responsibilities, projects or any other relevant topics that come up.

"Now I can see at a glance who's promised to deliver what and by when. More important, I can keep my own promises."

And Ted isn't the only business person who's come to rely on Lotus Agenda.

The Royal Bank of Canada is using it to monitor international economic and political activities. The accounting and consulting firm of Laventhol & Horwath is using it to track and support its computer systems all over the country. And the CAP International market research company is even using it to predict trends.



Agenda automatically files items in all relevant categories. Then you can view information from different perspectives.

The list goes on and on. The point is, Agenda can significantly help you, too. Especially now that it comes with an Activities Planner that gives you simple, step-by-step instructions so you can sit down and create your own personalized task manager.

If you'd like to learn even more about how Agenda can put you in control, just send us $10 for an Agenda demo kit. **Call 1-800-345-1043 and ask for demo kit AOB-3058 for 3.5" or AOB-3053 for 5.25"** (of course, we'll refund your $10 when you buy Agenda).

Then you'll see first hand how people like Ted Standish are working better, thinking better and solving problems better.

Not to mention remembering better.

Lotus Agenda

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NEW KID ON THE BLOCK: The NEC ProSpeed 286

The eighth member of the 286 laptop club has a 16-MHz processor that leaves 12-MHz competitors in the dust.

by Bruce Brown and Stephanie K. Losee

If you were anticipating more of a choice than these seven laptops offer you, hang on a bit—the NEC ProSpeed 286 is right around the corner. We looked at three prototype models in succession, from very preproduction to somewhat preproduction, in order to clue you in on what to expect in the coming months.

Don't expect magic—like other machines in this roundup, the ProSpeed is hefty in both pounds and dollars. But with its VGA screen, smooth keyboard, and 16-MHz processor, this battery-operated clamshell may offer the combination of features you've been looking for.

The ProSpeed 286 is slated to cost $5,099 with 1MB RAM, a 20MB 27-millisecond hard disk, VGA black-and-white screen, and a 16-MHz 80C286 processor. As the only 16-MHz battery-operated 286 laptop to hit the market, the NEC's one-third-faster clock crystal enabled it to blow away the other machines on our processor and memory tests. The drive and video times of the prototype we tested were nearer the middle of the road on our benchmark tests. The clock can be slowed to 8 MHz, and memory wait states will vary between zero and two, with a tested average of less than .7 wait states achieved by a Chips and Technology VLSI (very large scale integration) chip set that optimizes memory usage. The chip set will automatically copy the ROM BIOS to RAM.

Two memory-expansion options will be available: a 1MB upgrade for $799 and 4MB for $2,499. A standard driver is LIM EMS 4.0 compatible. You can fit as much as 5MB RAM in this machine, a number that can be matched only by the Toshiba T1600. A 40MB 29-ms. hard disk version of the ProSpeed 286 will cost $5,599, and a whopping 100MB 25-ms. variant will sell for $6,999.

There are other expansion options as well. You'll be able to buy 720K or 1.44MB 3½-inch floppy disk drives, 360K or 1.2MB external floppy disk drives, or for an even better deal, NEC's docking station. This unit combines the best of other vendors' efforts with one 8-bit and three 16-bit expansion slots, two half-height drive bays, and serial (2), parallel, external VGA monitor, mouse, and external keyboard ports. The list price of the expansion box will be $899, making the ProSpeed a viable candidate for buyers who want to invest in a single computer with office and home docking stations. The ProSpeed 286 can also take advantage of many options already available for the NEC MultiSpeed HD, such as $20 car battery adapter, internal modem, and external disk drives.

The ProSpeed 286 has a single LTX slot, a proprietary form-factor AT-compatible expansion slot that accommodates special-purpose add-in boards such as network cards, a SCSI interface, a 3270 board, and a voice-synthesis and -recognition board—all vaporware at this point. Memory upgrade, internal modem, and the internal expansion slots each have their own compartments on the NEC, so you don't need to trade off between them.

Standard software includes DOS 3.3, setup, a disk-caching program, and a telecommunications program on-disk; as well as a RAMdisk program,

ty price tag may prevent it from becoming popular as a casual laptop for the masses, but that's not its intended purpose. The ITC is right for anyone who needs both computer and telephone portability, and it's the only current alternative for people who want to transfer data via telephone, using other than conventional telephone lines. As cellular networks continue to expand, of course, the usability of this machine will increase as well. Not for executives only, the ITC could be appropriate for field engineers, salespeople, and perhaps even journalists on remote assignments within reach of cellular telephone networks. More likely, however, the ITC will remain a tool for the jet-set executive class, with a strong presence on motorhomes and corporate yachts.

MITSUBA CORP.

Mitsuba Ninja-12

What's that little beige thing in the corner? Oh, no, duck, it's a Ninja! Mitsuba Corp.'s Ninja-12 may have an unlikely name, but don't take it lightly. On the basis of screen quality, keyboard, and price, this machine deserves close attention. Most of the Ninja's specs read like those of the machines from better-known companies, but the $3,495 price is about $1,500 cheaper.

For the $3,495 base price, you get 1MB of RAM expandable to 5MB with user-purchased and -installable SIMM chips. You also get a 1.44MB 3½-inch floppy disk drive and a 20MB 27-millisecond hard disk. A 48-watt/hour nickel cadmium battery is standard, powering the Ninja for up to 4 hours, according to the vendor (we got 2 hours and 56 minutes in testing) and recharging in at most 6 hours.

EMS driver, and password security system—all in ROM. An internal 2,400-bps modem using the communications program will cost $599.

The keyboard feel rated a "very good"—on a par with the Toshiba T1600, a top choice in this group of laptop keyboards. There are 12 top-row function keys, and separate cursor-control and PgUp, PgDn, Home, and End keys. There's no embedded numeric keypad, so if you do a lot of numeric entry you'll need either to use the upper-row numbers or buy an external keyboard. No optional external numeric keypad is currently announced.

The VGA-compatible black-on-white LCD screen we tested suffered from prototype disease, even on the third model we reviewed. In text mode the screen is quite pleasant, but its timing problem is particularly noticeable in graphics mode, when the screen overscans tremendously. This screen failed several of our VGA compatibility tests, but these problems will most likely be corrected by the time the product ships. Maximum resolution is 640 by 480 pixels, and the ProSpeed 286 will run software calling for MDA, CGA, EGA, or VGA screens. A separate, standard software driver will provide Hercules compatibility. If you hook up an external monitor, the NEC can run monochrome, CGA, EGA, VGA, or multiscanning monitors.

The case is 3.5 by 13.0 by 14.8 inches (HWD), longer and more reminiscent of a briefcase than some of the other clamshell models. The NEC is somewhat hefty, weighing in at 14.6 pounds without battery and between 16.6 and 19.0 pounds with battery. The smaller cartridge battery (not tested) will sell for $199, the larger battery "slice" for $399. This 4.4-pound wonder lasted for 3 hours and 21 minutes on our battery rundown test and took 6½ hours to recharge. Power-saving utilities include auto-shutdowns for the hard drive, screen backlight, and modem.

Slated for release in late spring, the NEC ProSpeed 286 has as much to offer as the top competitors available today. Once NEC fine-tunes the screen, the ProSpeed's pleasing keyboard, superfast processor, and reasonably priced expansion options could make this laptop a strong force in the market. Weight is still a problem, but at about $500 less than the Compaq SLT/286, there will be one more competent 286 laptop to consider. Even so, our wish list hasn't gotten any shorter. ■

Bruce Brown is a frequent contributor to PC Magazine. *Stephanie K. Losee is a staff editor of* PC Magazine.

NEC ProSpeed 286, NEC Home Electronics, 1255 Michael Dr., Wood Dale, IL 60101; (312) 860-9500.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3½-inch floppy disk drive, DOS 3.3, $5,099; with 40MB hard disk, $5,599; with 100MB hard disk, $6,999. 1MB RAM upgrade, $799; expansion unit, $899; internal battery, $199; carrying case, $129.

CIRCLE 806 ON READER SERVICE CARD

INCREDIBLY INEXPENSIVE

The base price of the Mitsuba also includes one parallel port, a serial port, and a 9-pin RGB external monitor connector. There's also an external floppy-disk-drive port for an optional 1.2MB 5¼-inch floppy that costs $309. An external bus port awaits an optional expansion chassis that's not yet available. On the right side of the machine there's a plug for a $61 17-key numeric keypad. All the prices so far sound pretty good, but catch this one: an internal proprietary slot will hold an optional 2,400-bps Hayes-compatible modem that Mitsuba sells for just $230. It makes you kind of wonder, doesn't it?

If you're wondering who Mitsuba Corp. is, you're not alone. This California company has been in business since 1982, when Mitsuba released its first product, an add-on floppy disk drive for the Apple II. The Ninja-12 was released in February 1989. The first 250 units sold (300 have been sold as of this writing) had dark brown cases, as did the first two versions tested in PC Labs. Newer models have more typical light beige cases, which I suppose makes them "good" Ninjas.

The Ninja-12's screen is marvelous, almost as good as that of the Compaq SLT/286. The dark letters on a light background have terrific contrast, and the screen is very bright—battery conservation turns off the backlighting if the screen doesn't change for a set period of time. You can set the screen shut-down time as well as power down an inactive hard disk drive according to a time you specify using the ROM-resident Award Software CMOS Setup program. Through this screen, you can also set or disable LIM 4.0 expanded memory, choose between screen modes, set the processor speed (6 or 12 MHz), and set the date and time. The setup screen is always available.

The screen, a backlit CCFT (cold cathode fluorescent tube) LCD, is MDA and double-scan CGA compatible, with a maximum resolution of 640 by 400, but it looks more like EGA in text mode. For best results with an external monitor, Mitsuba recommends using a color EGA display, though CGA and MDA monitors will work as well.

PC MAGAZINE FACT FILE

Mitsuba Ninja-12
Mitsuba Corp., 650 W. Terrace Dr., San Dimas, CA 91773; (800) MIT-SUBA, (714) 592-2866.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3½-inch floppy disk drive, $3,495. Carrying case, $61; DOS 3.3, $91.
In Short: You may not have heard of it, but the Ninja-12 has a gorgeous paper-white screen (although it offers only CGA double-scan resolution), a very responsive keyboard, and a list price $1,500 less than its larger name-brand competitors. Good performance and a good deal, sold only through dealers.

CIRCLE 417 ON READER SERVICE CARD

The keyboard has a firm feel; it instantly became my favorite after the Toshiba T1600. The 82-key unit has ten function keys across the top with two more accessed by an Fn key. The Fn key also activates the embedded numeric keypad, several screen controls, and turbo and normal speed selectors. There are separate cursor-control keys as well as keys for PgUp, PgDn, End, and Home.

The Ninja is light on software. All you get besides the ROM-based setup program is an EMS driver. DOS is a $91 extra, so add that cost when comparing its list price with other machines'. This machine is so well-priced that the company ought to include DOS and live with the $100 price hike.

HAVE
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WILL
TRAVEL.
KODAK

Introducing the perfect companion for your laptop computer: the new Kodak Diconix 150 plus printer.

Hundreds of thousands of laptop users loved the Diconix 150 printer. Now there's a 150 plus. It delivers improved print quality, on plain paper, and is faster than ever. It's still the smallest, lightest, quietest printer in the world.

• Faster than ever—180 CPS. • Improved print quality—even higher resolution and improved font design. • Prints on plain paper. • Improved paper handling, easily handles tractor feed and cut-sheet paper. • So compact and light you can carry it anywhere—3.1 lbs. • So quiet you can use it anywhere. • The proven reliability you expect from Kodak.

The Kodak Diconix 150 plus printer. Now you can read what you write before you get back to the office. For details, and the name of your nearest dealer in the U.S. or Canada, call 1 800 255-3434.

Portable power for the printed page.

The new vision of Kodak

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CIRCLE 363 ON READER SERVICE CARD

286-BASED LAPTOPS: SUMMARY OF FEATURES

(Products listed in ascending price order)

AT A GLANCE	GRiDCase 1520	Mitsuba Ninja-12	HP Vectra LS-12	Toshibe T1600	Zenith SuperSPort 286
Base price	$3,495	$3,495	$4,879	$4,999	$4.999
Base configuration	1MB RAM, two 1.44MB floppy disk drives	1MB RAM, 20MB hard disk, 1.44MB floppy disk drive	1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, DOS 3.3	1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, DOS 3.3	1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, DOS 3.3
Price of configuration tested	$5,905	$3,495	$6,727	$5,128	$4,999
Tested configuration	1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, gas plasma screen, DOS 3.3, battery	Same as base configuration	2MB RAM, 40MB hard disk, modem	1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, extra battery	Same as base configuration
Microprocessor	80C286	80L286	80C286	80C286	80C286
Speed	10 MHz	6/12 MHz	6/12 MHz	6/12 MHz	6/12 MHz
Dimensions (HWD, inches)	2.3 x 11.5 x 15	3 x 12.5 x 13.5	3.1 x 12.2 x 12.2	3.3 x 12.3 x 12.8	3.1 x 12.2 x 15.4
Weight with battery pack (lbs.)	11.5	15.4	14.6	11.75	14.5
MEMORY					
Wait states	1	0, 1	0	1	0
Minimum RAM	1MB	1MB	1MB	1MB	1MB
Maximum RAM	4MB	5MB	2MB	5MB	2MB
EMS drivers	LIM EMS 4.0	LIM EMS 4.0	LIM EMS 4.0	DOS 3.2 EMM.SYS	LIM EMS 4.0
STORAGE					
Standard storage devices	Two 1.44MB floppy disk drives	20MB hard disk, 1.44MB floppy disk drive	20MB hard disk, 1.44MB floppy disk drive	20MB hard disk, 1.44MB floppy disk drive	20MB hard disk, 1.44MB floppy disk drive
Optional hard disk drives	20-, 40-, 100MB	None	40MB	None	40MB
Optional floppy disk drives	1.44MB (external), 360K	1.2MB (external)	1.44MB	360K (external)	360K (external)
SCREEN					
Screen type	Gas plasma	Supertwist backlit LCD	Electroluminescent supertwist backlit LCD	Supertwist backlit LCD	Supertwist backlit LCD
Dimensions (W x H, inches)	8.75 x 5.75	8.25 x 5.25	8.25 x 6.25	9 x 5.75	6.25 x 8.25
Maximum resolution (pixels)	640 x 400	640 x 400	640 x 400	640 x 400	640 x 400
Video modes	CGA	MDA, double-scan CGA	Double-scan CGA	CGA, EGA	Double-scan CGA
Readability	Good	Very good	Very good	Very good	Very good
KEYBOARD					
Number of keys	72	82	80	86	79
Feel	Fair	Very good	Good	Very good	Good
POWER					
Battery type	Internal removable nickel cadmium	Internal removable nickel cadmium	External detachable nickel cadmium	Internal removable nickel cadmium	External detachable nickel cadmium
Official battery life (hours)	0.5–1.5	3–4	3–4	1.5	4

—Editor's Choice

	Compaq SLT/286	ITC 286 CAT
	$5,399	$7,595
	640K RAM, 20MB hard disk, 1.44MB floppy disk drive	1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, DOS 3.3 battery, adapter, modem, phone, carrying case
	$8,319	$7,595
	2.6MB RAM, 40MB hard disk, DOS 3.3, modem	Same as base configuration
	80C286	80C286
	8/12 MHz	6/12 MHz
	4 x 13.5 x 8.5	4.1 x 15.4 x 14.6
	14	19
	1	0
	640K	640K
	3.6MB	2.6MB
	DOS 3.2 EMM.SYS	LIM EMS 4.01
	20MB hard disk, 1.44MB floppy disk drive	40MB hard disk, 1.44MB floppy disk drive
	40MB	None
	1.2MB, 360K	None
	Supertwist backlit LCD	Electroluminescent supertwist backlit LCD
	8 x 6	9.25 x 6.0
	640 x 480	640 x 400
	MDA, CGA, EGA, VGA	MDA, CGA, EGA
	Excellent	Good
	82	88
	Good	Very good
	Internal removable nickel cadmium	Internal gel cell
	1.53–3	2

The Mitsuba Ninja-12 makes good use of lights, with indicators just below the screen for power on, turbo mode, hard disk and floppy disk access, CapsLock, NumLock, and ScrollLock. One of the best deals around, the Ninja sells for $3,495 with 1MB of RAM and a 20MB hard disk.

CHICONY CONNECTION

The manual has great line art and good explanations, if you aren't bothered by reading documentation written by an obviously nonnative writer. While Mitsuba says this machine is manufactured specifically for them based on their specifications, the box said Chicony. That's acceptable, but a manual that mentions years of trouble-free operation and states, "The only thing you can do is cleaning the cabinet," causes one to pause. My favorite line in this manual is "If you want to install any peripherals to your computer, please refer to Chapter 3 for details and install them now." (I tried, but I couldn't find the page slot.)

But enough fun. This is a serious computer that scored well on our benchmark tests. It's basically in line with the other machines in the class, except for its slower screen. The Ninja is a bit on the heavy side, 16 pounds with the large internal battery, but it's only 3 by 12½ by 13½ inches (HWD), about the same as some other machines.

The Mitsuba Ninja-12 comes with a 1-year warranty and is sold by dealers throughout the country. By the time this issue hits the newsstands, you may have already heard more about this machine. If it's the first of a new class of high-quality 286 laptop clones, then this market is going to take off in a big way. The Ninja-12 may have no appreciable market share right now, but hang on—it may be the best deal around.

TOSHIBA AMERICA INC.

Toshiba T1600

Here they go again. Toshiba continues to improve its laptop computer lineup, with the T1600 its latest entry in the 80286-processor-based class. The T1600 combines 286 performance with a good screen, an excellent keyboard, a moderately fast 20MB hard drive, and a full complement of DOS and utility software at just under the $5,000 price point. Some of the best news is that they've kept the weight relatively low; at 11.7 pounds with one battery, the T1600 is the second lightest laptop in this series.

The T1600's 80C286 processor runs at 12 MHz, with an option to turn it down to 6

"IBM's newest Proprinter models have arrived with another load of features and functions to please users..."

—PC Magazine

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—PC Week

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—PC Magazine

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III

At last count there were nearly one hundred 9-pin printers to choose from.

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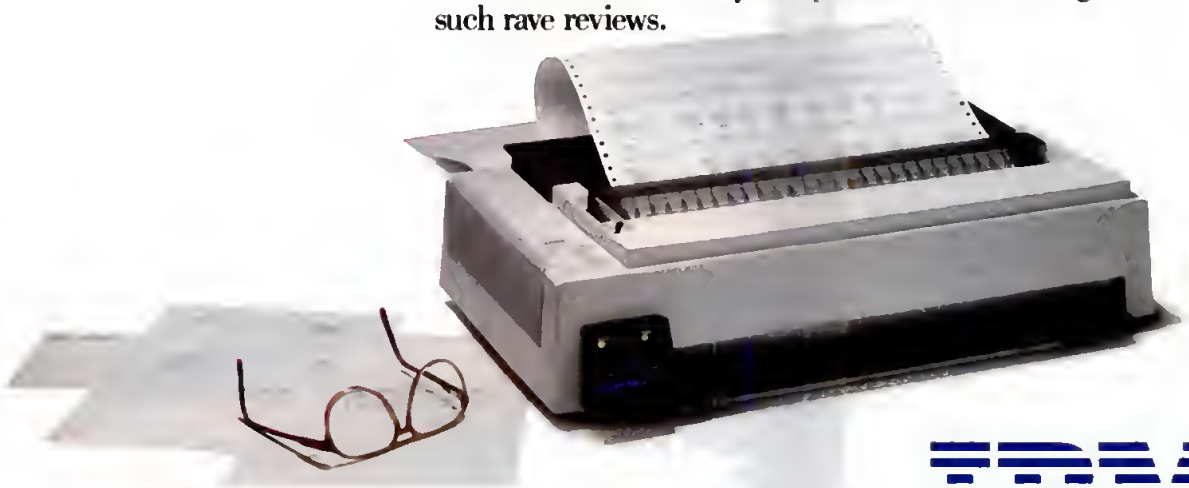

IBM®

286-BASED LAPTOPS: SUMMARY OF FEATURES

(Products listed in ascending price order)

	GRiDCese 1520	Mitsube Ninja-12	HP Vectra LS-12	Toshiba T1600	Zenith SupersPort 286
POWER					
Charge time (hours)	12	6	8–12	6–8	8–12
Voltage	10.8V	12V	12V	7.2V	12V
Amperage	1.7A	4A	4A	2A	4A
120/240V power supply	●	●	●	●	●
Car battery adepter	Optional	O	O	Optional	O
Battery conservation techniques	Screen and hard disk shutdown	Backlight and hard disk shutdown	*Battery Watch;* screen, hard disk, and modem shutdown	Backlight and hard disk shutdown, AutoResume mode, CPU sleep mode	Screen, hard disk, ports, and CPU shutdown
I/O AND EXPANSION					
External displays supported by built-in video hardware	CGA	MDA, double-scan CGA, EGA	Double-scan CGA	MDA, CGA, EGA	Double-scan CGA
Ports	Serial, parallel; external keyboard, external floppy disk drive, expansion bus, 9-pin RGB	Serial, parallel; external floppy disk drive, expansion bus, 9-pin RGB	Serial, parellel; external floppy disk drive, expansion bus, 9-pin RGB	Two serial, one perellel; external floppy disk drive, expansion bus, numeric keyped, 9-pin RGB	Serial, parallel; external floppy disk drive, expansion bus, numeric keypad, 9-pin RGB
Slot type	Two ROM sockets	Proprietary slot for modem	None	Two for 2MB memory cards, proprietary slot for modem, proprietary internal expansion slot	None
STANDARD SOFTWARE					
Disk-based programs	None	EMS driver, *Top Brass Executive*	DOS 3.3, HP utilities (disk cache, setup, terminal), GW-BASIC	DOS 3.3, disk cache, keyboard accelerator, screen accelerator	DOS 3.3, EMM, RAMdisk utility, *ZCache*
ROM-based programs	None	Setup	None	None	None
OPTIONS					
Math coprocessor	80287	80287	80C287	80C287	80C287
Modem (bps)	2,400 ($595)	2,400 ($230)	2,400 ($449)	2,400 ($349)	1,200 ($299), 2,400 ($499)
Cerrying case	$60	$61	$99	$89	$59

—Editor's Choice ●—Yes O—No

MHz if necessary for software compatibility. The standard 1MB of RAM operates with one wait state and can be configured as conventional memory, extended or LIM 3.2 expanded memory, virtual memory, or hard RAM. You can also add memory on optional $1,299 2MB cards, two of which can be accommodated for a system maximum of 5MB.

Standard equipment includes a 1.44MB 3½-inch floppy disk drive, a 27-ms., 20MB hard disk drive, one parallel and two serial ports. There are also ports for an external 5¼-inch floppy disk drive, an RGB external monitor, and a numeric keypad as well as a socket for an optional external expansion chassis. The expansion chassis is a good concept in general, but Toshiba's version of the concept is a $999 box that has five XT-compatible 8-bit slots and requires a $199 interface board. Unless you really need to run a specific 8-bit card, the expansion chassis sounds like a good option to pass up.

TWO BATTERIES

There's room for two batteries (one is standard, the second costs an additional $129), a Toshiba proprietary expansion card, and a slot for a built-in modem. A modem is not standard, but Toshiba has two 2,400-bps Hayes-compatible modem options, a $399 model that fits in the expansion slot and is easily user installable, and a $349 model that fits in the dedicated modem slot but requires dealer or factory installation. If you're going to go with a

	Compaq SLT/286	ITC 286 CAT
	3	10
	12V	12V
	2.4A	2.3A
	●	●
	○	●
	Screen, hard disk, ports, and CPU shutdown	Backlight and hard disk shutdown
	VGA	MDA, CGA, EGA
	Serial, parallel; external floppy disk drive, expansion bus, VGA	Serial, parallel; external floppy disk or tape drive, phone, video
	None	One full-length 16-bit
	Compaq EMM, disk cache, power conservation, RAMdisk, screen saver, setup	DOS 3.3, EMM, *Mirror II*, print spooler
	None	None
	80C287	80287
	2,400 ($599)	1,200 (included)
	$89	Included

The Toshiba T1600 makes on-the-road operation a breeze. The two front-accessible compartments hold two internal rechargeable nickel cadmium batteries to extend battery life. A machine configured with 1MB of RAM and a 20MB hard disk costs $4,999.

Toshiba modem, the better idea is to go with the internal version so that you can use the expansion slot for other purposes, such as Toshiba's new Ethernet network card.

The overall size of the T1600 is 3⅕ by 12⅕ by 12½ inches (HWD). Even with an optional second battery, the combined weight is only 12.6 pounds.

The T1600 comes standard with a special version of MS-DOS 3.3 as well as a slew of other programs, including a disk-caching program, a screen accelerator, a keyboard accelerator, and a printer spooler. There's also a built-in pop-up window program that tells you how much battery power is left in either of the two possible installed batteries and information about several resettable system-convenience parameters, including computer speaker off/on, audible battery alarm, internal modem off/on. It also tells you whether AutoResume Mode, CPU Sleep Mode, or hard drive or screen backlighting power-off battery-conservation modes are enabled. A user manual and DOS manual are both on-disk, written in a hypertext cross-referenced fashion; both on-line manuals are informative, easy to use, and good examples of a hypertext application.

AutoResume Mode, when enabled, lets you turn off your computer without exiting your current application. The T1600 uses an internal backup battery power to maintain the system's memory until the computer is powered up again. The internal battery is able to hold onto the memory for quite a long while, because the system's CMOS memory chips need power only intermittently—perfect conditions for a small battery. A second internal battery maintains the clock and calendar, system configuration, and the settings for the pop-up window.

The T1600's screen is a pleasure to use. The backlit supertwist LCD screen is EGA compatible, with a maximum resolution of 640 by 400 pixels. The display color is a

FACT FILE

Toshiba T1600
Toshiba America Inc., Information Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; (800) 457-7777, (714) 583-3000.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3½-inch floppy disk drive, DOS 3.3, $4,999. 2MB RAM upgrade, $1,299; expansion chassis with card, $1,198; carrying case, $89.
In Short: Toshiba's first battery-operated 286 laptop is a winner. The EGA-resolution screen is kind to the eyes, and the keyboard is simply great—it feels good and has the right keys in the right places. Battery time is fairly low, but otherwise, this 11.6-pound unit is an aggressive competitor.

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512K, 360K Drive, 84-Keyboard

Standard System Features:

- 10MHz Nec V20 CPU with 1.5 times the power of the 8088!
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- Set-up & Operating instructions.

Standard Pre-Built Configurations:

PCV20 AD-II With 512K, Hard Disk Drive, Monitor & Video Card					
Drive / Video	1 Floppy	2 Floppy	20MB	30MB	40MB
Mono	$669	$740	$924	$950	$1077
RGB	$839	$914	$1098	$1124	$1241
EGA	$1059	$1134	$1318	$1344	$1461
VGA/Mono	$859	$929	$1113	$1139	$1266

PC BRAND 286/12 $875

Now Using C & T "Neat" Chip Set

12 MHz Clock, Zero Wait Operation,
Norton SI 15.3 •Landmark™ Speed 16MHz
512K, 1.2MB or 1.44MB Drive, 101- Keyboard

Standard System Features:

- 80286 Processor Operating at 12MHz with Zero Wait States delivering 16MHz Effective Throughput
- 512K RAM expandable to 4MB on the System board using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller
- Enhanced 101-key AT Style Keyboard
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit)
- Small foot print case with 5 Disk Drive bays

Options:

- Full size 5 drive case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable
- Full or Mini Size Tower® Case

Standard Pre-Built Configurations:

286/12 With 512K, Hard Disk Drive, Monitor & Video Card				
Drives / Video	20MB 1:1 MFM	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM
Mono	$1310	$1414	$1523	$1654
EGA	$1704	$1808	$1917	$2048
VGA 16 bit	$1875	$1979	$2088	$2219
VGA/Mono	$1540	$1644	$1753	$1884

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Ideal Novell Server!

20 MHz Clock, Zero Wait Operation
Norton SI 20.4 • Landmark™ 25.9MHz
512K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- 80286 Processor Operating at 20MHz w/Zero Wait States in interleave mode delivering 26MHz Effective Throughput
- 512K RAM expandable to 4MB on the System board using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM, and PCNET compatibility
- Built-in System Board LIM 4.0 EMS hardware drivers
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full or Mini Size Tower ® Case • Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable

Standard Pre-Built Configurations:

286/20 w/512K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM	110MB-28MS 1:1 RLL	150-16MS 1:1 ESDI	320-16MS 1:1 ESDI
Mono	$1590	$1699	$1830	$2096	$2800	$3523
EGA	$1984	$2093	$2224	$2490	$3250	$3917
VGA 16 bit	$2155	$2264	$2395	$2661	$3500	$4088

PC BRAND 386/SX-20 $1099

20 MHz Clock, Zero Wait Operation
Norton SI 23.0 • Landmark™ 23.5MHz
512K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- 80386SX Processor Operating at 20MHz delivering 24MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB 80ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM, and PCNET compatibility
- 8 Slot motherboard design (6 16Bit & 2 8Bit)
- Medium foot print case with 5 Disk Drive bays (Shown with optional Mini Size Tower® Case)

Options:

- Full or Mini Size Tower ® Case • Factory Installed RAM Upgrades
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- Compaq® Style LCD or Plasma Portable

Standard Pre-Built Configurations:

386SX-20 w/512K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM	110MB-28MS 1:1 RLL	150-16MS 1:1 ESDI	320-16MS 1:1 ESDI
Mono	$1590	$1699	$1830	$2096	$2800	$3523
EGA	$1984	$2093	$2224	$2490	$3250	$3917
VGA 16 bit	$2155	$2264	$2395	$2661	$3500	$4088

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Standard System Features:

- Intel 80386 Processor Operating at 20MHz with Zero Wait States in interleave mode delivering 30MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 or Weitek Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit & 2 32Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- Full or Mini Size Tower ® Case • 8MB 32Bit RAM Card Upgrade
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Standard Pre-Built Configuration:

386/20 With 1024K, Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM	110-28MS 1:1RLL	150-16MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$2490	$2599	$2730	$2996	$3700	$4423
EGA	$2884	$2993	$3124	$3390	$4200	$4817
VGA16bit	$3055	$3164	$3295	$3561	$4350	$5988
VGA/Mono	$2720	$2829	$2960	$3226	$3930	$4653

PC BRAND 386/25 $2250

25 MHz Clock, Zero Wait Operation
Norton SI 28.3 • Landmark Speed 35MHz
Norton SI 30.5 • Landmark Speed 43.5 w/Cache
1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

- Intel 80386 Processor Operating at 25MHz with Zero Wait States in interleave mode delivering 35 to 44 MHz Effective Throughput
- 1024K RAM standard expandable to 16MB via 32Bit RAM boards using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
- Enhanced 101-key AT Style Keyboard
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387 or Weitek Co-Processor Support
- Phoenix BIOS with full MS/DOS, OS/2, XENIX, NOVELL, 3COM and PCNET compatibility
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (6 16Bit & 2 8Bit & 2 32Bit)
- Medium foot print case with 5 Disk Drive bays

Options:

- 32KB Cache Processor • Weitek Co-processor • Tower ® Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD or Plasma Portable • 8MB 32Bit RAM Card

Standard Pre-Built Configurations:

386/25 With Hard Disk Drive, Monitor & Video Card						
Drives / Video	40MB-40MS 1:1 MFM	40MB-25MS 1:1 MFM	71MB-18MS 1:1 MFM	110MB-28MS 1:1RLL	150-16MS 1:1ESDI	320-16MS 1:1ESDI
Mono	$2840	$2949	$3080	$3346	$4100	$4773
EGA	$3234	$3343	$3474	$3740	$4500	$5167
VGA 16 bit	$3405	$3514	$3645	$3911	$4700	$5338
VGA/Mono	$3070	$3179	$3310	$3576	$4330	$5003

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1024K, 1.2MB or 1.44MB Drive, 101-Keyboard

Standard System Features:

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- 1024K RAM Standard Expandable to 16MB
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Dual Hard Drive/Floppy Drive Controller, 977.6 KB/SEC Caching Controller w/ESDI Configurations
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- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- AMI BIOS With Full MS/DOS, 05/2, XENIX, NOVELL, 3COM and PCNET compatibility
- 8 Slot motherboard design
- Full size case with 5 Disk Drive bays (Shown with Optional Full Size Tower ® Case)

Options:

- Custom configurations w/Name Brand peripherals of your choice
- Weitek Co-Processor • Tower® Case • Factory Ram Upgrades

Standard Pre-Built Configuration:

386/33 With Hard Disk Drive,Monitor & Video Card						
Drives / Video	40MB-25MS 1:1 MFM	71MB-18MS 1:1 RLL	110MB-25MS 1:1 ESDI	150MB-16MS 1:1HSDI	320MB-16MS 1:1ESDI	640MB17MS 1:1 MFM
Mono	$3498	$3629	$3895	$4649	$5322	$7022
EGA	$3892	$4023	$4259	$5049	$5716	$7416
VGA 16 bit	$4063	$4194	$4460	$5249	$5887	$7587
VGA/Mono	$3728	$3859	$4125	$4879	$5552	$7252

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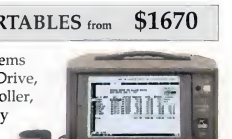

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Standard Pre-Built Configuration:

Portable System Processor and Drive Options				
Drive / CPU	286/12	286/20 or 386/SX-20	386/20	386/25
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20MB	$1979	$2279	$2909	$3110
40MB	$2100	$2400	$3050	$3200
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3200; EGA, 80286-12, 1MB, 40MB HD, FDD 3595
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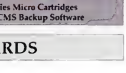

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CIRCLE 119 ON READER SERVICE CARD

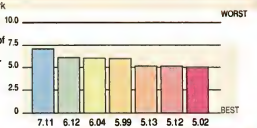
PC LABS BENCHMARK TESTS: 286-BASED LAPTOPS

The Compaq SLT/286 is the laptop of the hour with its dazzling VGA screen, innovative design, and impressive disk performance.

PROCESSOR AND MEMORY BENCHMARK TESTS

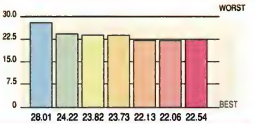
80286 Instruction Mix — Elapsed Time (seconds)

The **80286 Instruction Mix** benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



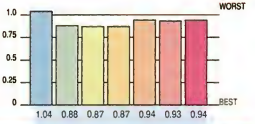
Floating-Point Calculation — Elapsed Time (seconds)

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



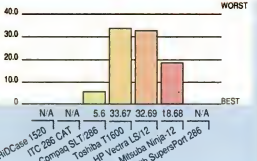
Conventional Memory — Elapsed Time (seconds)

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.



Extended Memory — Elapsed Time (seconds)

The **Extended Memory** benchmark test times the read/write speed of extended memory found in 80286- or 80386-based computers. The test switches the processor into protected mode to function and then back to real mode using BIOS calls.



N/A—Not applicable: this computer does not support extended memory.

All of the battery-operated 286-based laptops tested in this roundup are advertised as 12-MHz machines, except for the 10-MHz GRiDCase 1520. Although the Compaq SLT/286 and ITC CAT 286 are both rated at 12 MHz, in our NOP benchmark tests (the results of which are not shown) they displayed times indicating 11.8-MHz and 11.2-MHz operation, respectively. Compaq explains that this discrepancy is caused by a refresh delay used to maintain 100 percent bus compatibility. This wait state allows the processor to finish a 12-MHz operation before attempting any I/O on the 8-MHz bus (such as accessing the external floppy disk drive).

ITC takes a slightly different approach, actually toggling the CPU speed to 8 MHz when performing I/O. This methodology is slightly less efficient than Compaq's; because the bus and CPU run at two separate speeds, the ITC comes in just behind the Compaq in terms of performance. Both the ITC and Compaq machines run their memory at 12 MHz, and their performance times are on a par with that of the Toshiba T1600.

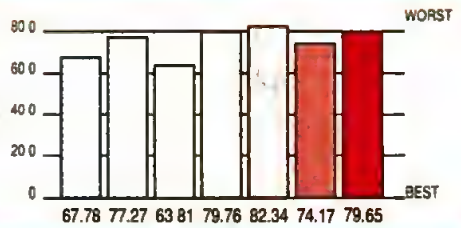
While its CPU times are not at the head of the pack, the Compaq SLT/286 makes up ground with the fastest hard disk and display of all the review units. The 40MB hard disk in the SLT/286 employs a 1:1 interleave, with a rated data-transfer rate of 12 megabits per second. Combined with a 16-bit VGA adapter driving what is arguably the finest display available on a laptop today, this disk makes Compaq the overall performance champ of the current battery-powered 286 competitors.

Battery run times range from 41 minutes for the GRiDCase 1520 to almost 4 hours for the Zenith SupersPort 286. The key difference among the machines is the battery ratings, with the Zenith sporting a 12-volt 4-amp/hour battery pack while the GRiD has only a 10.8-volt 1.7-amp/hour battery. Because of the difference between the battery capacities, the relative performance of the batteries has been omitted from the composite view.

DISK BENCHMARK TESTS

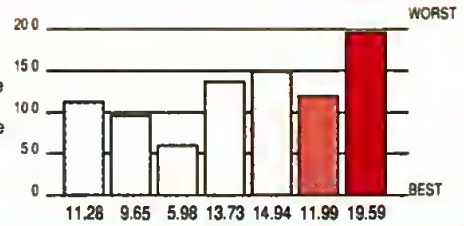
DOS File Access (Small Records) — Elapsed Time (seconds)

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



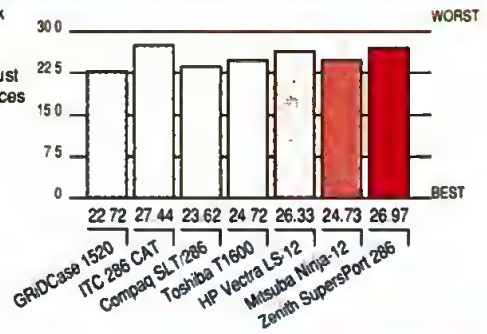
DOS File Access (Large Records) — Elapsed Time (seconds)

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk-subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

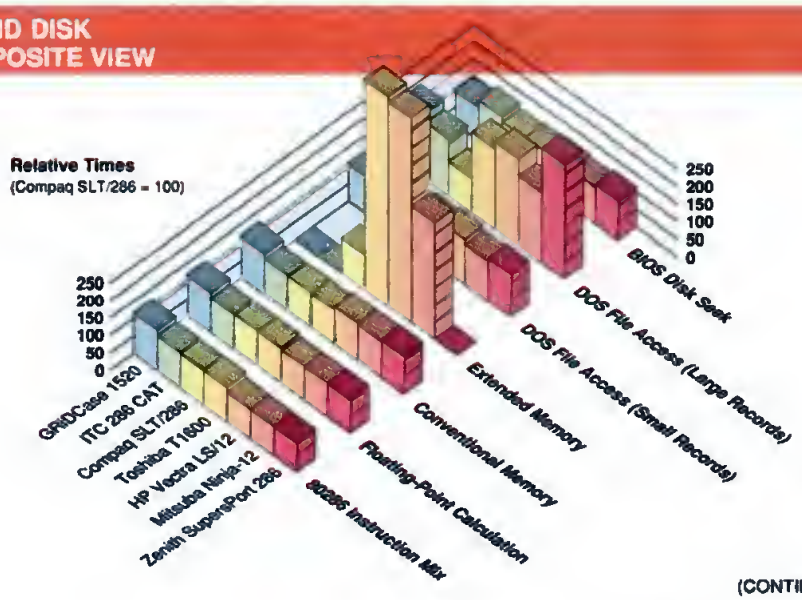


BIOS Disk Seek — Elapsed Time (milliseconds)

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW



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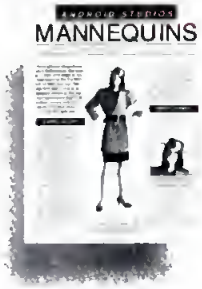

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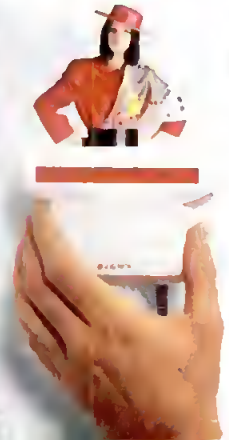

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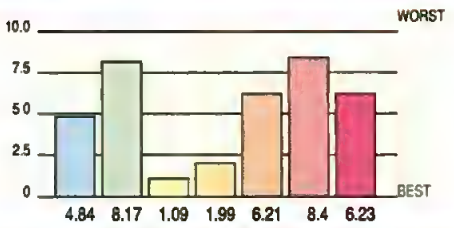
CIRCLE 182 ON READER SERVICE CARD

BENCHMARK TESTS: 286-BASED LAPTOPS

PC LABS

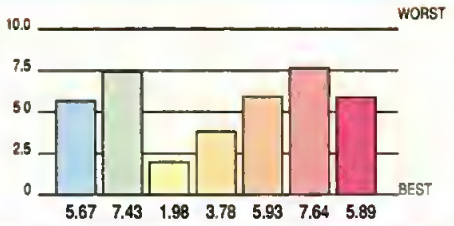
Direct to Screen — Elapsed Time (seconds)

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



Video BIOS Routine with Scrolling — Elapsed Time (seconds)

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

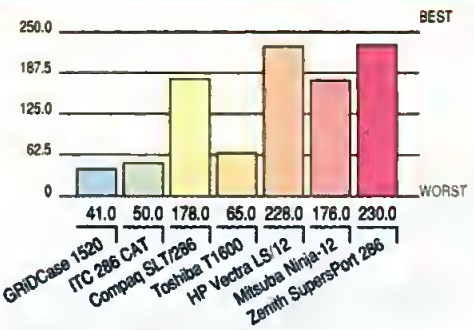


Video BIOS Routine Without Scrolling — Elapsed Time (seconds)

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

Battery Rundown Times — Elapsed Time (minutes)

The **Battery Rundown** performance test involves teletyping five screens of text to the laptop's display, then writing a 15K file to the PC's hard disk once every minute until the battery runs out of power. Power conservation is disabled.

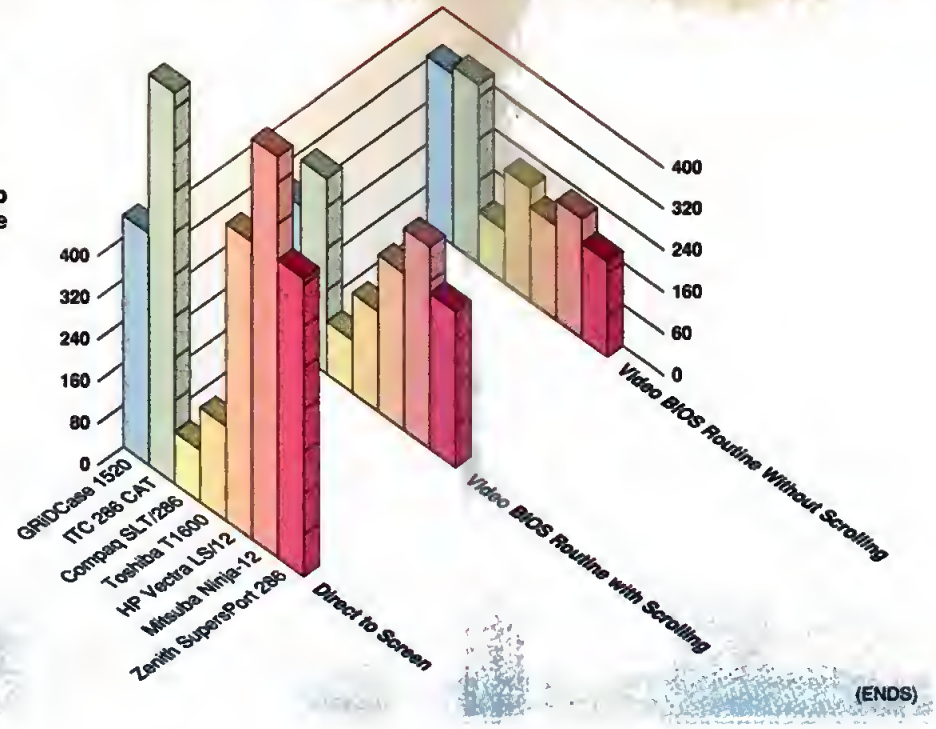


This laptop roundup inaugurates PC Labs' Battery Rundown benchmark test, which measures battery life. The test was designed to simulate a worst-case scenario, bypassing the new power-conservation features offered with many of today's 286-based battery-operated laptop models.

First the batteries are completely discharged, then recharged according to manufacturer specifications. The test involves teletyping five screens of text to the laptops' displays, and then writing a 15K file (including the data that contains the elapsed run time of the test) to the hard disk. This procedure is repeated once a minute until the computer's battery runs out of power. The test is run with all power-conservation features disabled. The results are reported in minutes and do not appear as part of the composite view.

VIDEO BENCHMARK TESTS: COMPOSITE VIEW

The Compaq SLT/286's 16-bit VGA screen not only looks dazzling, it stands apart from most of its competitors in benchmark-test performance. Only the Toshiba T1600's sharp 640 by 400 EGA screen is in the same league.



pleasing blue against a very light gray background. You can set the screen font with software, choosing between 8-by-16 and 8-by-14 character boxes as well as choosing a double or thinner single-dot font for intensified characters such as those in boldface. The screen contrast and brightness are easily adjusted.

SOLID-FEEL KEYBOARD

The Toshiba has by far the best keyboard of the laptops tested in this series. The positive keyboard action and solid feel have none of the mushy or hesitant feeling of many laptop units. The layout is also convenient, with an embedded numeric keypad activated by a left-side special function (Fn) key. You do not have to hold down a shift, Alt, Ctrl, or Fn key for Home, End, PgUp, or PgDn keys—a decided advantage for those commonly used keys. There are 12 programmable function keys arranged horizontally along the top row of the keyboard.

Battery life is somewhat disappointing. The case can take two removable rechargeable nickel cadmium batteries. One comes standard, but you'll probably want to buy a second one for $129 if you intend to run the machine away from AC power often. Battery life is estimated at 90 minutes with one battery installed and twice that with two batteries, but in our testing (albeit with the power-conservation features turned off) our best time was 64 minutes with one battery. That's not much. It's certainly better than the ITC, with its big screen and cellular phone, and better than the GRiD, with its gas plasma screen, but the Zenith, Hewlett-Packard, and Compaq laptops all get much better battery life. To be fair, the Zenith and HP batteries weigh 4½ pounds each, compared with the Toshiba's .9 pounds, but the Compaq battery is only 1.7 pounds. Toshiba sells a $279 separate battery charger that can charge three batteries at once; otherwise it takes from 6 to 8 hours to charge the batteries using the standard AC combination power supply and battery charger. If you have to do a lot of field work, you might consider buying a custom battery bandolier.

Toshiba's T1600 is a laudable addition to Toshiba's full line of laptops. During the last several years, Toshiba has built a following of loyal laptop users, many of whom will consider upgrading from earlier, lower-power models to the T1600. With its low weight, terrific screen, and superior keyboard, the Toshiba T1600 can make you forget its disappointing battery life. Bargain for a good deal on the street, and you may find yourself with a top-quality laptop at a bargain-basement price.

ZENITH DATA SYSTEMS

Zenith SupersPort 286

Display clarity is one of the most compelling considerations in buying a laptop, and Zenith has long had a well-deserved reputation for bright, eye-pleasing screens. Zenith was the first to market a backlit supertwist LCD screen in a battery-operated laptop, a preemptive move that left competitors with dimmer LCDs scurrying for better technology. Zenith combined its winning screen with a winning clamshell design to come up with the now-popular SupersPort 286.

The $4,999 SupersPort 286 is based on

The Zenith SupersPort 286 may have a trendsetting design, but its battery is less than elegant: this laptop lasts 3 hours on battery power by virtue of its huge, 4½-pound dumbbell-shaped battery. You'll pay $4,999 for 1MB of RAM and a 20MB hard disk.

a 12-MHz 80C286 processor and comes standard with 1MB of RAM running without wait states. This machine can take an optional 1MB more RAM, priced at a lofty $1,299. Memory-management software included is compatible with LIM EMS, Version 4.0. Other standard software includes Zenith's own version of MS-DOS 3.3 Plus, *ZCache* disk-caching software, and a RAMdisk program.

The SupersPort 286 also comes standard with one 1.44MB 3½-inch floppy disk drive, a 20MB hard disk drive, and several I/O ports. The 40MB version is $5,599. You can hook up an external CGA monitor, an external $399 5¼-inch 360K floppy disk drive, or a $129 external numeric keypad. The external devices are all optional, but the plugs to connect them are standard.

NOT LIGHT OR TINY

With the standard 48-watt/hour battery attached, the SupersPort 286 weighs 14½ pounds and measures 3 1/10 by 12 1/5 by 15 2/5 inches (HWD). It's not a light or tiny machine, but its weight has to be balanced against battery life. The 48-watt/hour battery has a claimed life of 4 hours per charge, an accurate estimate: our battery test ran almost 3 hours and 50 minutes.

Recharging takes about 8 hours with the computer off and 12 hours with it running on AC power. If you need more than 4 hours or so, you can always pack more batteries, but at 4½ pounds apiece, the optional $289 units quickly add uncomfortable weight. The roughly 4-hour running time is good for most transcontinental flights, the informal benchmark test for laptop battery operation. If you want less weight, an optional 30-watt/hour 2.7-pound battery costs $169 and a 2.55-pound 26-watt/hour version is $159.

The SupersPort 286 has several battery-conservation settings available in the Monitor program (Zenith's term for setup). You can configure choices and times to shut down power to an inactive screen, hard drive, and ports, and even slow down the CPU to 6 MHz.

Zenith's screen is easy to work with. The screen is hinged near the rear top of the computer and folds up. Slide controls for brightness and contrast are located just below the right and center of the screen, respectively. The screen's maximum resolution is 640 by 400 in double-scan CGA mode. In text mode, fonts look almost as good as EGA fonts on other laptops.

The Zenith keyboard is also good, though the feel is not as crisp as the Toshiba's. The keyboard arrangement puts ten function keys across the top row, and an embedded numeric keypad is activated by an Fn key located on the bottom-left corner of the keyboard. The cursor-control keys are organized in an inverted-T arrangement on the lower-right side and, in conjunction with the Fn key, they activate the Home, End, PgUp, and PgDn keys.

Zenith sells a $499 expansion chassis that has three 8-bit slots for XT-compatible cards. While 8-bit cards are limiting, this method costs less than half the price of Toshiba's similar unit that has five XT slots for $1,198, including an interface card.

There are two internal modem options, a 1,200-bps model for $299 and a 2,400-bps version for $449. There are also two choices for math coprocessor chips. Zenith sells a regular 10-MHz 80287 chip for $525, but a better choice is a Power Miser 80C287 12-MHz chip for $699. Both chips are user-installable. The SupersPort 286 scored well on benchmark tests, with all timing results in roughly the middle of the pack.

STILL GOING STRONG

The bottom line is that even though the SupersPort 286 was announced in spring 1988, it's still a competent machine. It has longer battery life than the closely compet-

FACT FILE

Zenith SupersPort 286
Zenith Data Systems, 100 Milwaukee Ave., Glenview, IL 60025; (800) 842-9000, (312) 699-4800.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3½-inch floppy disk drive, DOS 3.3, $4,999; with 40MB hard disk, $5,599. 1MB RAM upgrade, $1,299; expansion chassis, $499; carrying case, $59.
In Short: This 12-MHz machine uses the screen that convinced many that battery-operated laptops could make sense. You'll get close to 4 hours of operation with its 4½-pound battery, making it one of the top choices for true on-the-road use.

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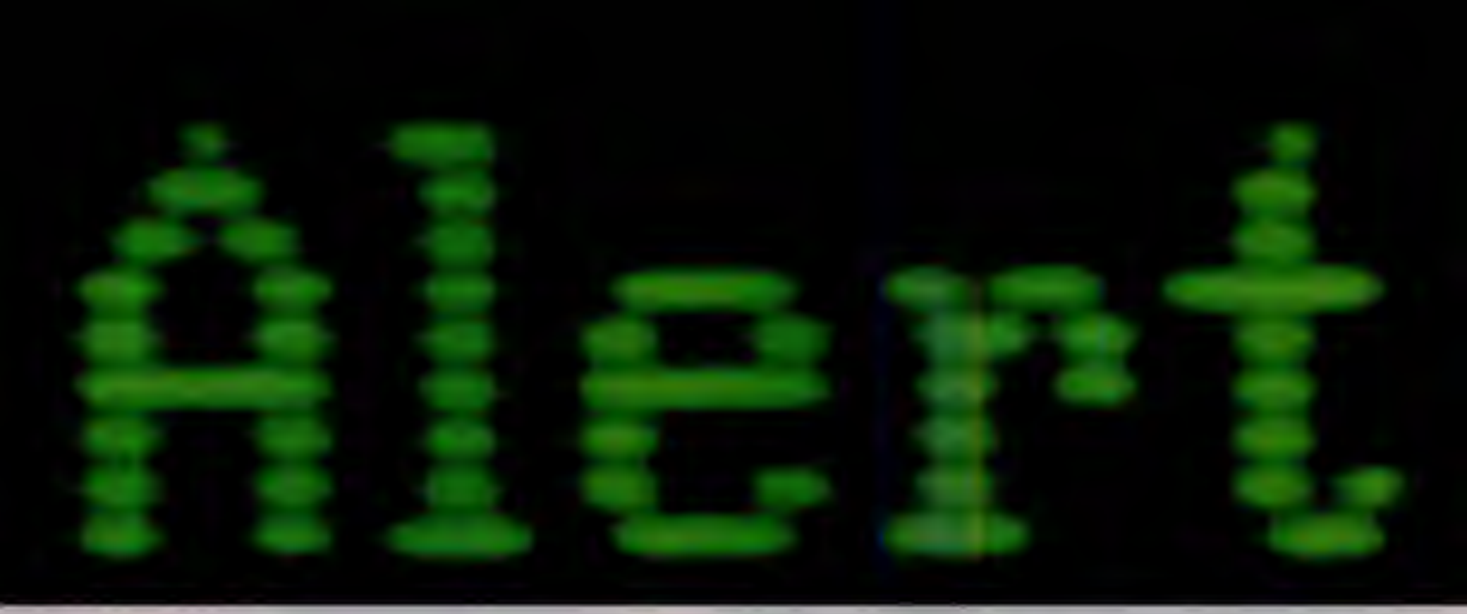

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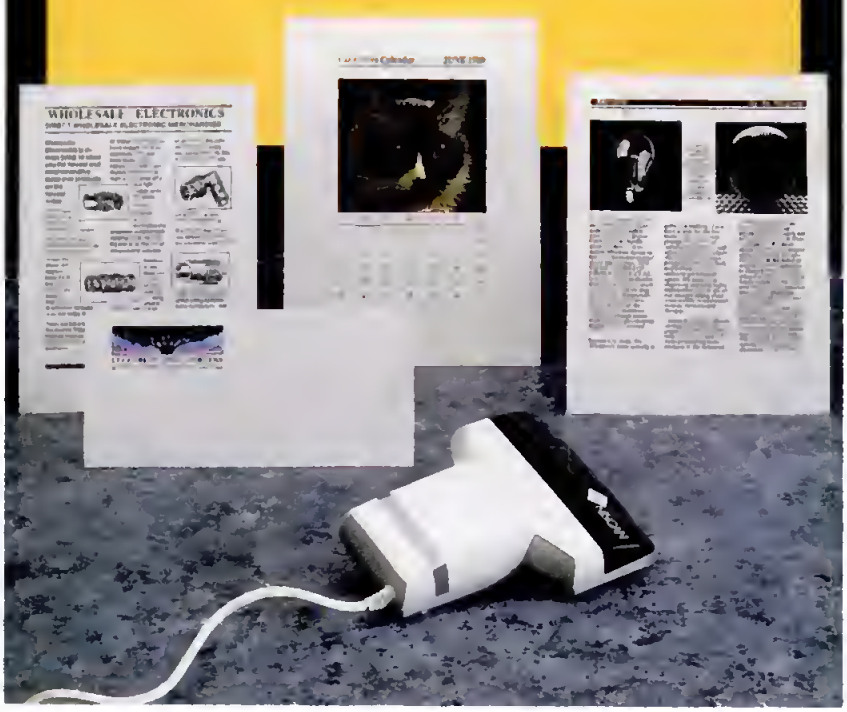

CIRCLE 104 ON READER SERVICE CARD

EDITOR'S CHOICE

PC MAGAZINE

• Compaq SLT/286

It's no secret that the Compaq SLT/286 has changed the way we look at 286-based, battery-operated laptops. Its innovative case design, gorgeous screen, excellent performance, battery-conservation techniques, and expansion options make it a prime candidate for the title of "desktopworthy laptop." At $5,399 for 640K RAM and a 20MB hard disk, the Compaq SLT/286 isn't inexpensive, but in the high-priced laptop market, this machine remains competitive with the other name brands.

The Toshiba T1600 bears mention as well. Housed in a more traditional laptop case, this model boasts a noteworthy EGA-resolution screen, superlative keyboard, and relatively low weight. Short battery life works against the T1600, but that's the necessary trade-off for cutting down on poundage. A bit less pricey than the Compaq SLT/286, the T1600 sells for $4,999 for 1MB RAM and a 20MB hard disk.

The newest name in this laptop roundup, Mitsuba's Ninja-12, might sound a little silly, but you'll stop smirking when you discover that its list price of only $3,495 includes 1MB RAM and a 20MB hard disk; a keyboard second only to that of the Toshiba T1600; and a very-high-contrast screen that, although it's only double-scan CGA, rivals the Compaq SLT/286 in text mode. The Ninja-12 makes the prospect of investing in a "laptop clone" look rosier every day.

itive Toshiba T1600, but its CGA-compatible screen falls short of the T1600's EGA. Unfortunately for Zenith, just 10 percent more than the SupersPort 286's list price buys a Compaq SLT/286, which weighs half a pound less and has a superior VGA screen, the standard by which others are measured. As the laptop marketplace continues to expand, it will be interesting to see Zenith's next move. ■

Bruce Brown is a frequent contributor to PC Magazine.

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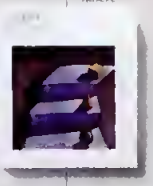

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CIRCLE 368 ON READER SERVICE CARD

16-bit VGA Cards Stretch The Standard

by Alfred Poor

Though they're still called VGA cards, these high-performance boards stretch the term, offering resolutions far beyond the 640 by 480 pixels of that standard.

Can advances in technology exceed demand? On one hand, we may be pushing that limit now with PC display adapters. On the other hand, we may be witnessing the arrival of the adapters that everyone will be buying in the years ahead.

This class of card comprises 16-bit extended VGA cards capable of displaying a resolution of 800 by 600 pixels or better. These cards are impressive: the jump from an Apple II to an IBM PC monochrome text screen was quite a leap in its time, as was the thrill of moving up from CGA to EGA. But the eye-popping, high-density, multihued views you get with these extended display modes can startle even the most jaded keyboard jockey. And these cards are fast. The 16-bit data path can move about twice as much information as the original 8-bit VGA cards.

In this issue we review 15 high-performance VGA cards. We asked makers of cards with 16-bit-wide data paths capable of generating Super VGA's 800 by 600 resolution to send us their highest-end offering. In response, Allstar Microsystems Corp., AST

PHOTOGRAPH: THOM O'CONNOR

Research, ATI Technologies, Communication Inter-Globe, Genoa Systems Corp., Hewlett-Packard Co., Intelligent Data Systems, Orchid Technology, Paradise Systems, Renaissance GRX, SOTA Technology, STB Systems, Tatung Company of America, Tecmar, and Video Seven supplied us with graphics adapter cards that generally have impressive specifications. Cards from Advanced Technology Information Systems, Ahead Systems, Cardinal Technologies, Everex, Gemini, Novas Computrade, NSI Logic, Personal Computer Graphics Corp., Quadram, and Sigma Designs unfortunately were unavailable at the time of the review.

These high-performance cards range in price from $299 to $799, for an average of $639.26. Though they cost more than 8-bit adapters capable of displaying 800 by 600 resolution—$125 more on average—they'll speed up the graphical user interfaces for which that resolution is admirably suited. And they simply give you more room to grow than do plain-vanilla 8-bit VGA-only adapters, at the same time ensuring compatibility with software written for the VGA standard. (See the table "VGA Cards: Getting the Best Deal.")

VGA CARDS: FINDING THE BEST DEAL

	8-bit DRAM	16-bit DRAM	16-bit VRAM
1K VGA: 1,024 x 768 pixels (512K RAM, 16 colors)	$599.00*	$588.75	$1,099.00†
	$409.00*	$421.00	$731.00†
Super VGA: 800 x 600 pixels (256K RAM, 16 colors)	$434.50	$523.90	
	$264.40	$334.85	
Basic VGA: 640 x 480 pixels (256K RAM, 256 colors)	$431.33‡		
	$338.80‡		

Average list price
Average street price

* These prices are for STB Systems' VGA Extra/EM, the only 8-bit card we found capable of displaying 1K VGA resolution.

† These prices are for Video Seven's V-RAM VGA card.

‡ These averages include the prices of IBM and Compaq VGA cards, which cost considerably more than their "basic VGA" peers and are less heavily discounted.

VGA cards come in an astounding variety of configurations. If you just consider their assorted data path widths, type of memory chips, amount of RAM, and resolution capabilities, you've got six different possibilities. And that's excluding the ones you're not likely to buy. For example, you could purchase a 512K RAM card capable of generating 256 colors in 800 by 600 resolution, but since the proposed Super VGA standard currently supports only 16 colors, there would be little point in opting for such a card now. (You can always invest in additional memory chips later.)

We think that of all these options, 16-bit cards capable of displaying Super VGA resolution are currently your best deal. Besides giving you the ability to move up to 800 by 600 resolution, these cards perform text-intensive tasks nearly twice as fast as 8-bit cards do, according to our speed tests of the Video Seven card line. The Video Seven tests also reveal that while 16-bit VRAM cards process text and graphics data slightly faster than 16-bit DRAM cards do, the speed differences are negligible. As this diagram shows, the average street price for 16-bit DRAM cards is quite low, nearly $200 below their average list.

TSENG AND IBM

This bumper crop of high-performance cards, most of which were brought to market in the latter part of 1988, owes its existence to two technologies: the 16-bit VGA chip, first introduced by Tseng Laboratories in October 1987, and the programmability that IBM built into the registers of its VGA boards. Discovered by graphics adapter makers as they "reverse engineered" the chip set of IBM's VGA card, this register programmability has enabled VGA board manufacturers to offer higher resolutions.

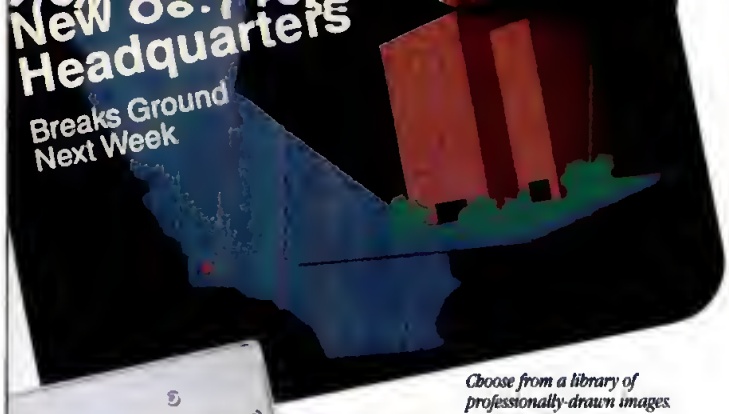
Which brings us to 800- by 600-pixel resolution. Called *Super VGA* by the Video Equipment Standards Association (VESA), this resolution appears to be on its way toward becoming a standard. Super VGA resolution has been actively promoted by the members of VESA—a group of nine companies, most of which are graphics board makers—in order to encourage software companies to write drivers to support it (see "Multiscanning Monitors for VGA and Beyond," *PC Magazine*, May 16, 1989). But beyond 800 by 600 resolution with 16 colors, Super VGA specifications have yet to be determined. VESA members say they may eventually agree to support 800 by 600 with 256 colors, as well as 1,024 by 768.

The ability to display 800 by 600 resolution can be easily programmed into VGA cards, however, and the 50 percent more pixels that Super VGA offers makes it ideally suited for displaying graphical interface environments like *Microsoft Windows* and *GEM*, as well as desktop publishing, presentation graphics, and CAD software.

The new resolutions offered by these VGA cards can also offer significant benefits for text-oriented applications. All the cards tested offer text modes beyond the standard 25 rows of 80 columns. Imagine a spreadsheet displayed in more than 60 rows and 130 columns—more data than you can typically get on a printed page!

MOVING THE PIXELS

Each time the resolution and number of colors an adapter is called upon to handle increases, the amount of data displayed per screen grows larger. Black-and-white 640 by 200 resolution CGA requires a mere 16K; 16-color 640 by 350 EGA needs 109K; but Super VGA's 16-color 800 by 600 resolution requires 234K per screen. With this much data to move back and forth between the display adapter and your PC, an 8-bit data bus becomes a bottleneck—comparative video benchmark tests of Video Seven's 8-bit and 16-bit VGA cards showed the 16-bit card to be nearly twice as fast. Almost all new computers being purchased are either 286- or 386-based machines (no, I won't fall into the



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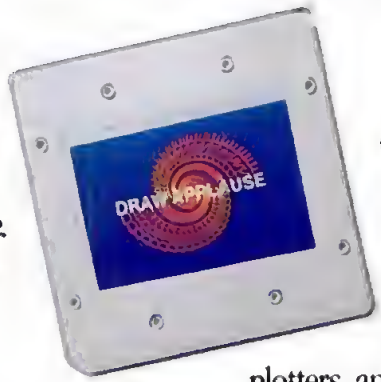

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trap of arguing which of *those* is the new standard) and offer a 16-bit data bus.

The 16-bit buses of these cards make them faster than 8-bit cards. Still, manipulating the large amounts of data these higher resolutions require per screen can slow them down. The manufacturers therefore have turned to other design improvements to enhance performance.

RAM BIOS, VRAM, AND FIFO

There are three main ways that the card manufacturers try to get the most performance they can from these enhanced VGA cards: BIOS relocation, video RAM, and FIFO (First In, First Out) buffers. While these can offer some improvement, they are not always effective.

BIOS relocation is the most common. Offered by the majority of these high-performance cards, this approach copies the video BIOS code into your computer's system RAM, where the code will presumably perform faster than it would when called from ROM chips on the video card. In fact, this improvement is of limited value. On an 8-MHz AT (the PC Labs standard), the 16-bit ROM operates at about the same speed as the RAM, so there is often little measurable gain. BIOS relocation does appear to help 8-bit cards, though judging from our speed tests of the Video Seven line, it doesn't make them as fast as 16-bit cards.

Video shadowing doesn't really pay off until you get into faster CPU clock speeds. However, many 386 computers offer BIOS shadowing in RAM as part of their internal setup options, which is redundant with the BIOS relocation offered by these cards. In fact, the 386 shadowing is better because it uses extended memory while the BIOS relocation drivers use system memory (below 640K). The drivers typically take about 12K of RAM, which is not going to cause RAM-cram by itself but is one more demand on the limited 640K real estate.

And, finally, BIOS relocation does not help at all with programs that write directly to the display adapter hardware, bypassing the BIOS altogether. Programs like *Lotus 1-2-3*, *Microsoft Windows*, and many graphics packages perform this end run to boost performance. As a result, don't expect to see any benefit from BIOS relocation with this sort of program.

Another approach consists of using video RAM, or VRAM, chips; it is depicted in detail in the VRAM diagram. Offered by Video Seven on VGA cards, this method of performance enhancement increases the number of ports from one to two. These ports load and unload video data from the CPU so that it can be sent to the display. Although dual-ported VRAM gives you a faster display, these chips cost considerably more than standard dynamic RAM (DRAM) chips. The term *video RAM* is somewhat confusing since so-called *dynamic RAM* chips are technically video chips; the main difference between DRAM and VRAM chips is that VRAM chips use two ports.

Some manufacturers have attempted to get the benefits of VRAM while using less-costly DRAM. Western Digital has built a first in, first out (FIFO) buffer into its Paradise chip for extended VGA cards. This is designed to process data like VRAM, moving data in one side and out the other, but using custom circuitry to manage the process so that it can be handled by standard DRAM chips. The concept is sound, but its benefits were not clear in the PC Labs benchmark tests. A number of the cards used Paradise VLSI chips, but there was little evidence that these cards were faster than those of their competitors.

These VGA cards owe their existence to two technologies: the 16-bit VGA chip and the register programmability of the VGA boards.

256K VS. 512K RAM

Because we asked the manufacturers of these high-performance cards to send us their top-of-the-line cards, 12 of the 15 we reviewed were outfitted with 512K. This impressive RAM load will not affect the performance of the cards one iota, at least not in terms of speed. It will, however, let you display more colors.

A card outfitted with 256K will give you 256 colors at 640 by 480 resolution, 16 colors at 800 by 600 resolution, and 4 colors at 1,024 by 768 resolution. With a 512K card you can display 256 colors at 800 by 600 and 16 at 1,024 by 768. But since at present Super VGA supports only 800 by 600 resolution with 16 colors, you need no more than 256K of RAM to display it. As boards outfitted with 256K of DRAM cost considerably less and can usually be field-upgraded to 512K, they may be the best buy, especially if you get the chips to upgrade the board from someone other than the board's vendor.

Whether you buy it with 256K or 512K, a board capable of displaying 800 by 600 offers color resolution combinations that are outside of the support of IBM's VGA standard (which goes no higher than 256 colors at 320 by 200 resolution or 640 by 480 with 16 colors). In order to take advantage of these higher resolutions, you must be able to configure your software to use them. Here you must rely on the card manufacturer to supply drivers.

Almost all of these cards offer high-resolution drivers for *AutoCAD*, *GEM*, *Lotus 1-2-3*, *Ventura Publisher*, and *Microsoft Windows/286;* less than half offer drivers for *Microsoft Windows/386*. Beyond that, just a handful of other packages are supported, depending on which the individual boardmakers think have merit. (Not all resolutions are supported by all drivers, either. For example, just because a board can produce 1,024 by 768 resolution does not automatically mean that you will get a driver to do that under *Windows*, even if a *Windows* 800 by 600 driver is supplied.) Make certain that the card you consider comes with the drivers you need; without them you will have to run the card as a standard VGA until a time comes when the resolution is routinely supported by software vendors.

Another necessity for the display of higher resolutions is a monitor that can handle the required scan frequencies. An 800 by 600 mode requires a 35-kHz horizontal scan rate, and this can be handled by many multifrequency monitors such as the NEC MultiSync II or the Taxan MultiVision 770 Plus. (The original NEC MultiSync cannot handle this mode.) Half of the cards tested offered resolutions as high as 1,024 by 768; in order to handle the 49-kHz scan rate that this requires, you need a higher-end monitor like the NEC MultiSync XL or the Taxan UltraVision 1000, though even with these you may find that flicker makes the screen less viewable.

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TESTING FOR VGA COMPATIBILITY

Originally developed as part of the new PS/2 series of computers and introduced with the line in April 1987, VGA is presently the highest mainstream video standard. Unfortunately, though the field of non-IBM-produced add-on VGA cards is far more compatible with the standard than it was a year ago, there are still some problems largely because there is more than one IBM VGA standard. There is the VGA that is built into the Micro Channel motherboards on PS/2 machines like the Model 50 and the Model 70. This is very similar but *not* identical to the standard bus adapter card that IBM built for the PS/2 Model 30.

Our VGA performance tests focus on compatibility with the PS/2 motherboard implementation of VGA since that is the one that most programs expect to find. It is worth noting, however, that some of the cards in this review offer alternative settings that allow you to choose between the expansion card and the motherboard compatibility standards.

In these tests, we checked for compatibility with the IBM standard at a number of levels. We looked at BIOS compatibility, testing the reproduction of color bars and the character attributes. We also checked for hardware compatibility, including panning and scrolling abilities and vertical blank interrupt.

All the cards we reviewed, with the exception of Continental Inter-Globe's Toucan VGA 1024, generally offer an acceptable level of compatibility, though most of them failed at least one or two of our compatibility tests.

LOOKING AHEAD

Will Super VGA become the new video standard? Ultimately, the answer is up to you. Along with processor and hard disk speed, the video board is one of the big three factors that determine system performance. The 16-bit cards are certainly faster than 8-bit models, but are they fast enough for you? That will largely be determined by the system you intend to use them with.

By the same token, your ability to take advantage of the higher resolution that Super VGA offers depends on the software you use. Until extended VGA resolutions become accepted well enough for software manufacturers to write drivers for them, they will be available for only a handful of applications that sport custom drivers written by the board manufacturers.

ALLSTAR MICROSYSTEMS CORP.

Peacock Plus EVGA

by Catherine D. Miller

A midrange-priced graphics adapter offering midrange performance, Allstar Microsystems Corp.'s $645 Peacock Plus EVGA goes beyond the norm in offering 1,024 by 768 resolution and some interesting utilities.

Engineered around Tseng Labs' VGA chip set, the 9¼-inch XT-height Peacock Plus board comes fully populated with 512K of 100-nanosecond VRAM. (You can buy the board partially populated with 256K VRAM, the Peacock, for $545.)

FACT FILE

Peacock Plus EVGA
Allstar Microsystems Corp., 13885 Alton Pkwy., Irvine, CA 92718; (714) 951-1884
List Price: With 256K RAM, $545; with 512K RAM, $645.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution)
In Short: The Peacock Plus EVGA's price and performance place it in the midrange, but its inclusion of a *Microsoft Windows/386* driver and its ability to display 1,024 by 768 distinguish it.

CIRCLE 396 ON READER SERVICE CARD

AST-VGA Plus
AST Research Inc., 2121 Alton Ave., Irvine, CA 92714-4992; (714) 863-1333
List Price: With 256K RAM, $599; memory upgrade kit, $159.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: Fast and high-priced, the AST-VGA Plus does not come with a 9-pin connector for TTL output.

CIRCLE 397 ON READER SERVICE CARD

EDITOR'S CHOICE

VGA Wonder
ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2; (416) 756-0718
List Price: With 256K RAM, $499; with 512K RAM, $699.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: One of the fastest boards of this bunch, the VGA Wonder is built around ATI Technologies' own graphics controller chip and features a bus mouse port and 9-pin, 15-pin, and VGA feature connectors.

CIRCLE 398 ON READER SERVICE CARD

You also can load video BIOS into system RAM with Allstar's FASTBIOS.SYS driver. Yet the Peacock Plus turned in only mediocre performance times in comparison with other boards tested for this review. In our *Microsoft Windows* performance tests, which address the *Windows* driver rather than the BIOS or the registers, the Peacock Plus generally recorded average times.

The Peacock Plus supports several extended text modes in addition to the VGA-standard 80 by 25 and 40 by 25 modes. All text modes are software selectable with the VMODE command, and the maximum text video mode is 132 by 44. Alternatively, you can replace ANSI.SYS with Allstar's EANSI.SYS to obtain the screen-control and keyboard-remapping features of ANSI.SYS.

The RAM-resident Zoom utility allows your graphics or CADD package to make use of the VGA controller's hardware scrolling, panning, and zooming capabilities. Allstar's font editor lets you modify or create new fonts, while the font loader will load a font from disk into video memory, allowing you to choose fonts from DOS rather than within an application program. The utility disk also includes device drivers for *Lotus 1-2-3*, *Microsoft Windows/286*, *Microsoft Windows/386*, *GEM*, *Ventura Publisher*, and *AutoCAD* that allow you to use the 800 by 600 and 1,024 by 768 extended graphics display modes.

The board automatically determines if it is installed in an 8-bit or a 16-bit slot. It offers a wide range of monitor support, with both a 9-pin DIN connector for digital output and a 15-pin analog connector for VGA. Between the two connectors, and accessible from the slot cutout in the back of your computer, four DIP switches enable you to select the monitor type and to indicate whether you are using one or two.

AST RESEARCH INC.

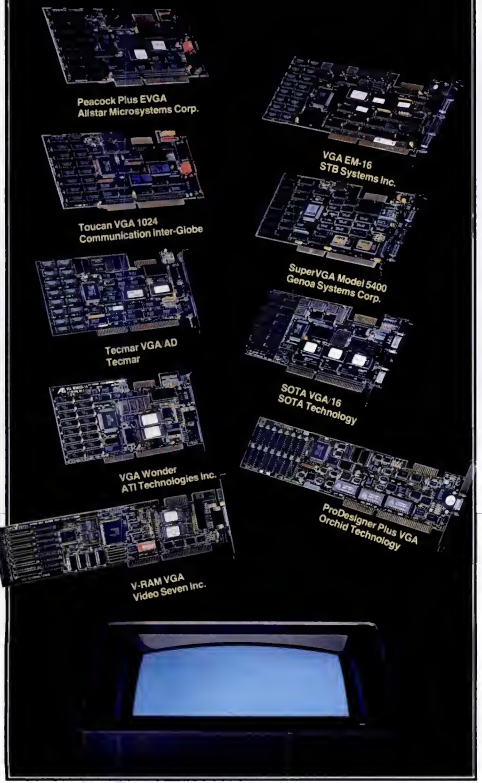
AST-VGA Plus

by Ken Shelby

The AST-VGA Plus is one of the most expensive cards we reviewed. The $758 you must shell out for the 512K version won't buy you the ability to display anything higher than 800 by 600 resolution, or even *Microsoft Windows/386* at that resolution, but it will get you a fast card.

512K VGA Cards Capable of 1,024 by 768 Resolution

Making up the high end of these high-performance cards, these nine VGA cards are loaded with 512K RAM and capable of 1,024 by 768 resolution. The 512K of RAM allows them to display either 16 colors in 1,024 by 786 or 256 colors in 800 by 600 resolution. Neither combination is currently supported by Super VGA, although they may be in the future.



With test scores indicating that it should perform especially well in text-based environments, the half-size card will work in either an 8-bit or a 16-bit expansion slot. The card, which is based on the Paradise chip set, is a snap to install. Clear, easy-to-follow instructions help you adjust the switches that control the setup, and one of the diagnostic programs included double-checks the settings. The installation of the Super VGA (800 by 600 by 16 colors) driver for *Microsoft Windows/286* is also quick and painless. AST supplies 800 by 600 drivers for the usual packages (*AutoCAD, GEM, Lotus 1-2-3,* and *Ventura Publisher*) as well as for *Framework II, Symphony,* and *WordStar*.

To improve response, the AST-VGA Plus includes a utility that runs the video BIOS from main system RAM. As with the rest of these cards, this made no difference in the speed tests.

The board looks well organized. Most of its chips are surface-mounts soldered to the card. The ROM BIOS and the optional 256K of additional video RAM are socketed DIP chips, while the standard 256K of video RAM DIP chips are soldered. All 512K of the DRAM chips are 100-nanosecond. The card has one 15-pin analog connector and supports MDA, HGC, CGA, EGA, VGA, and Super VGA.

In the PC Labs benchmark tests, the AST board failed to initialize modes 7 and 15 in the Direct Writes to Frame Buffer test. This is hardly surprising because the board is designed to be compatible with IBM's VGA display card for the XT, AT, and PS/2 Model 30 rather than with the built-in VGA of the PS/2. Like most of the other boards reviewed for this issue, the AST-VGA Plus also failed the Color Bar and Character Attributes tests.

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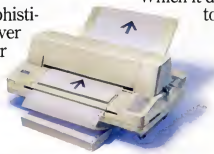

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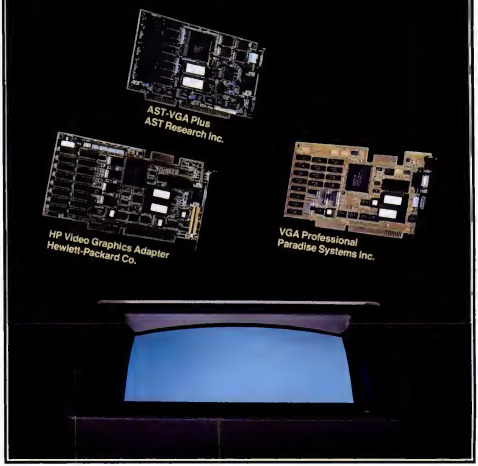
CIRCLE 242 ON READER SERVICE CARD

To improve response, the package includes a device driver program that runs the video BIOS from main system RAM instead of from the ROMs on the video card. As with the rest of the cards, this alteration made no difference in the speed tests. In a faster machine, this "shadowing" of the BIOS should yield an improvement. AST Research states that the board will be able to run at bus clock speeds of up to 12 MHz.

AST sells the 256K version of AST-VGA Plus for $599, as well as the AST-VGA, an 8-bit VGA card capable of displaying 800 by 600 resolution.

512K VGA Cards Capable of 800 by 600 Resolution

Outfitted with 512K of memory, these cards are capable of displaying 256 colors at Super VGA's 800 by 600 resolution. At present, however, the proposed standard supports only 16 colors—which requires only 256K of RAM.



ATI TECHNOLOGIES INC.

VGA Wonder

by Ken Shelby

The fastest high-performance VGA card we tested, ATI Technologies' VGA Wonder sports a midrange price ($699 for the tested 512K version of the card, $499 for a 256K version). And it's the only card to come bundled with its own mouse.

The VGA Wonder is unique in a number of ways. ATI, a Canadian firm, produces its own VGA controller chip instead of using one from a supplier like Paradise or Tseng Labs. The card contains only three surface-mount chips, but as our benchmark and performance tests show, ATI is doing something right.

The test unit came outfitted with the standard 256K of 100-nanosecond video DRAM DIP chips soldered to the board and the optional second 256K of 120-nanosecond socketed chips. It is capable of displaying 1,024 by 768 resolution and has four ports: 9-pin TTL and 15-pin analog monitor connectors, a VGA feature connector, and a port for the Microsoft-compatible bus mouse included in the package.

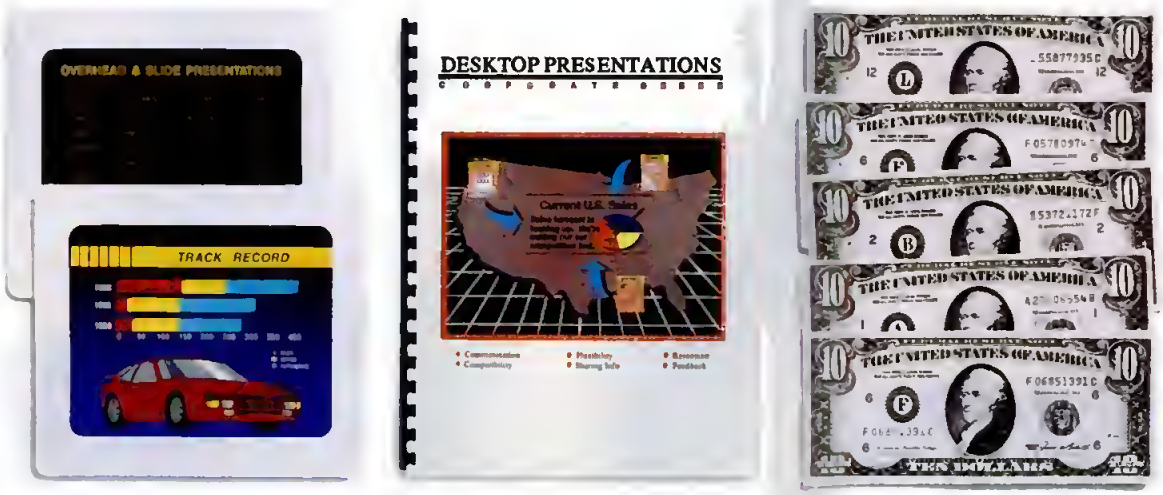
The mouse in the package that we reviewed was a Logitech bus mouse, but an ATI spokesperson said that there is no guarantee that this brand—or any mouse at all, for that matter—will be bundled with the board in the future. The logic of offering a free mouse, according to the ATI spokesperson, is that users seeking enhanced resolutions will probably want to use them with graphics-oriented packages that usually are controlled with a mouse. By connecting a bus mouse to the port of the VGA Wonder card, serial mouse users can free up both a slot and a serial address on their PC. ATI is simply making it easy to do so. A mouse driver is included.

The free mouse is offered, according to ATI, because users will probably use enhanced-resolution VGA cards with graphics-oriented packages, which usually support mice.

The VGA Wonder does have a few compatibility problems. Testing uncovered incompatibilities in the way that the VGA Wonder handles the CRT controller registers. The board failed the Vertical Blank Interrupt and the Pan and Scroll tests, which indicates possible flickering and jumping with graphics-intensive applications. It also failed the Color Bars and Character Attributes tests. None of these problems should significantly affect the card's performance, however

The card can also be faulted for its inelegant method of installing the 800 by 600 driver for *Microsoft Windows/286*. Most board makers supply drivers on a disk that the *Windows* setup program can read, making the selection of the appropriate driver a simple matter. ATI, on the other hand, requires the use of a program sup-

Easy To Get With The Program.



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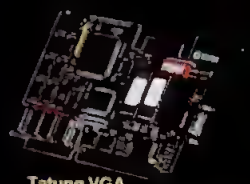
CIRCLE 743 ON READER SERVICE CARD

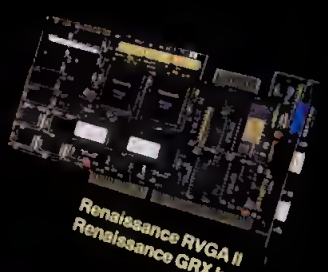
256K VGA cards

Equipped with only 256K of RAM, these three VGA cards run as fast as their 512K-laden brethren. And they're quite capable of displaying 16 colors at 800 by 600 resolution (the current Super VGA standard).

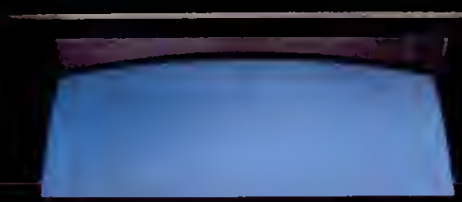


Tatung VGA
Tatung Company of America Inc.

Intelligent VGA Model 650
Intelligent Data Systems Inc.



Renaissance RVGA II
Renaissance GRX Inc.



plied with the board that alters the *Windows* setup disk. Supplemented by a READ.ME file containing important update information, this program requires you to remove the Microsoft EGA driver from the *Windows* setup disk and replace it with the ATI 800 by 600 driver. The new driver retains the name of the file it replaces, however, so selecting EGA in the *Windows* setup routine results in loading the ATI driver. The driver does work when it is finally loaded.

The VGA Wonder card lacks a high-resolution *Microsoft Windows/386* driver, as do more than half of its competitors. It does come with the basic five drivers supplied by all of the cards, as well as ones for *AutoShade*, *AutoSketch*, and *Symphony*. Considering its speed, wealth of features, and price, the VGA Wonder is a product worthy of notice.

COMMUNICATION INTER-GLOBE

Toucan VGA 1024

by Ken Shelby

The least expensive of the cards reviewed in this article by far, Communication Inter-Globe's Toucan VGA 1024's performance places it in the middle of the pack. Offering 512K of DRAM for $349 (a version with no memory is $199, and one with 256K is $279), the card is a real bargain, though it is likely to exhibit VGA compatibility problems.

The Toucan is unusual in that it possesses but one surface-mount chip, a Tseng Labs VGA controller. The other chips are of the older, dual-inline package type, many in sockets. The board is populated with fast 80-nanosecond DRAM chips, but judging from its performance on our tests, it doesn't appear to be taking advantage of them. The Toucan also has 9-pin TTL and 15-pin analog monitor connectors, as well as a VGA feature connector, and is able to display up to 1,024 by 768 resolution.

The PC Labs tests showed that the Toucan suffers from several incompatibilities with the VGA standard. At the BIOS level, it failed the Color Bars and Character Attributes tests, as did several other cards. The VGA Write Modes test showed that the card has problems with code that uses the graphics controller to perform logical operations on video data; the Toucan failed the Rotated 4, AND, OR, and XOR portions of this test. Problems in dealing with the CRT controller and sequencer registers were indicated by the card's failure on the

FACT FILE

Toucan VGA 1024
Communication Inter-Globe, 633 McCaffrey, St. Lawrence, Quebec, Canada, H4T 1N3; (514) 738-6580
List Price: With no memory, $199; with 256K RAM, $279; with 512K RAM, $349.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 resolution).
In Short: Though liable to exhibit serious VGA compatibility problems, the Toucan VGA 1024 is very inexpensive and offers a wealth of features, including the ability to display 1,024 by 768 resolution.

CIRCLE 399 ON READER SERVICE CARD

SuperVGA Model 5400
Genoa Systems Corp., 75 E. Trimble Rd., San Jose, CA 95131; (408) 432-9090
List Price: $699
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: Able to display 1,024 by 768 resolution and offering high-resolution drivers for seven applications, including *Microsoft Windows/386*, the SuperVGA Model 5400 is relatively expensive and the slowest of this group

CIRCLE 400 ON READER SERVICE CARD

HP Video Graphics Adapter
Hewlett-Packard Co., Customer Information Center, Inquiry Fulfillment Department, 19093 Pruneridge Ave., Cupertino, CA 95014; (600) 752-0900
List Price: With 256K RAM, $445; additional 256K, $225.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution)
In Short: Lacking drivers for *Microsoft Windows/286* and *Windows/386*, the HP Video Graphics Adapter offers midrange performance.

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CIRCLE 135 ON READER SERVICE CARD

VGA and NTSC: Putting Your Program on TV

by Alfred Poor

Hey! Look! My favorite programs are on TV. No, I'm not talking about "Miami Vice" or "Roseanne," I'm talking about my word processor, spreadsheet, and database programs.

This may not seem like a big deal until you realize that you are dealing with a regular video monitor.

Back in the old days of the Apple II, a composite video monitor was the standard display screen for home computers. Except for a rare appearance with a CGA card, composite monitors have not been used much on PCs. (EGA cards had a pair of RCA plugs, but the plugs never did anything.)

There are plenty of high-end tools, such as the Targa 16 board, that allow you to display images on TV monitors or capture pictures from video cameras. These high-resolution devices are supported by a limited number of programs and come with correspondingly high price tags ($1,500 and up for just the display adapter).

But until recently, you were out of luck if you wanted to see your PC programs on video. Willow Peripherals now offers the VGA-TV card, a full-length 8-bit VGA card that also has an RCA plug on the back that puts out a broadcast-quality NTSC (National Television Standards Committee) RS-170 composite video signal.

Why would you want this? In the first place, large composite video monitors and rear-projection screens cost far less than an analog display screen of similar size. The output can also be sent to a VCR; you can make tapes of desktop presentation graphics or record the screen output of an entire work session, which could form the basis for custom training materials or dramatic product demonstrations. Willow includes a demo disk with some impressive VGA graphics images.

The one limitation of the VGA-TV card is that it does not have a genlock capability to synchronize the video scan rate with an external source. You need genlock to be able to overlay images, such as those from a live camera and the VGA-TV, but you can use external devices to achieve this effect. When you do not need the NTSC feature, however, the VGA-TV behaves like a typical VGA card, including the production of 800 by 600 graphics.

Just about the only thing that the VGA-TV board can't do is capture an image from a TV signal and save it to disk. But Willow's other product, Publishers' VGA, can do exactly that. Publisher's VGA lets you capture screens from broadcast television, videotapes in a VCR, or from a video camera. Its program makes it easy to manipulate and adjust the picture. There are controls to alter the brightness and contrast and create special effects with the image. Since the program stores the last four images captured, you can scan through to find the best image. This same feature also makes it possible to recover from a mistake when altering the image.

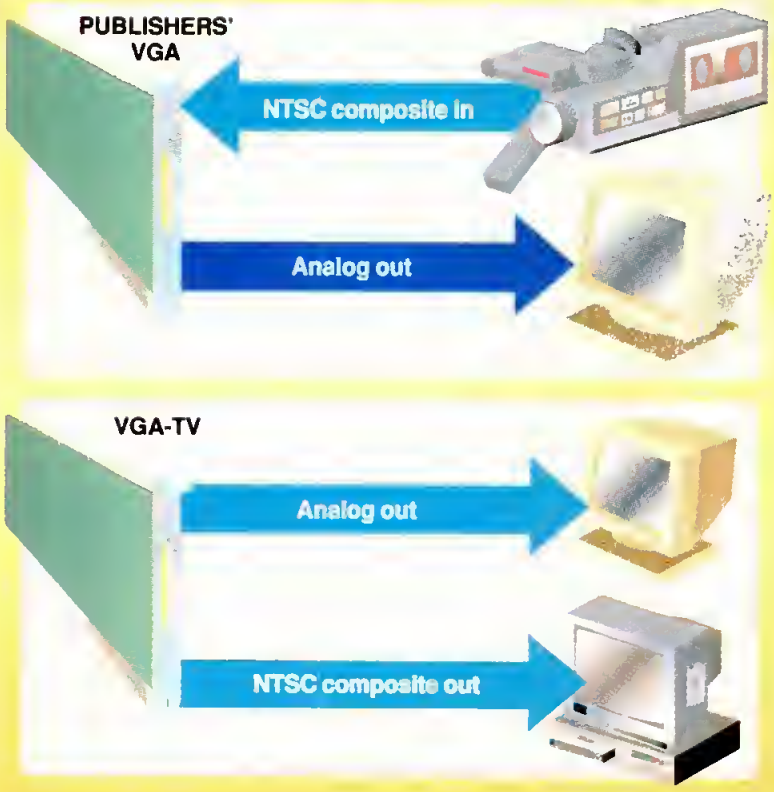
You can save your images, which come out in black and white using a 64-level gray scale, in a number of formats, including .TIF, Encapsulated

FACT FILE

Publishers' VGA
VGA-TV
Willow Peripherals, 190 Willow Ave., Bronx, NY 10454; (212) 402-0010
List Price: Publishers' VGA, $699; VGA-TV, $699.
Requires: PC, XT, AT, or compatible, VGA monitor; multiscanning monitor required for 800 by 600 display resolution.
In Short: A pair of VGA cards that process NTSC signals. The VGA-TV displays VGA signals on a TV screen, while the Publisher's VGA captures TV images.

CIRCLE 412 ON READER SERVICE CARD

TWO WILLOW CARDS ≤ ONE TARGA



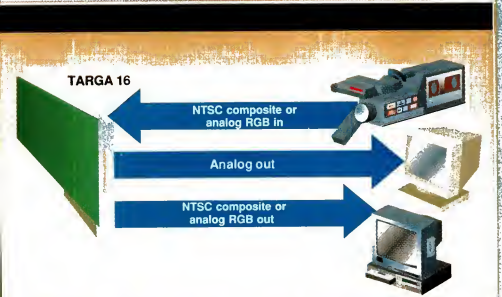
PostScript (.EPS), and *PC Paintbrush Plus* or *Publisher's Paintbrush*. These formats can then be used to incorporate the images into desktop publishing documents or picture databases. The Willow card offers some advantages over scanners as a method of capturing images on-screen, especially for three-dimensional objects or moving subjects.

Like its stablemate, Publishers' VGA works as a straightforward VGA when it is not watching television for you. Both cards performed well but not perfectly on the PC Labs benchmark tests. In general, the compatibility problems were confined to less critical areas that give many VGA cards trouble, such as the BIOS-level Color Bars and register-level Pan and Scroll tests.

There are dozens of other frame-capture boards available, such as the Targa. There are even other low-cost grabbers that work in conjunction with existing display cards, such as the Oculus-10 from Coreco that works with a VGA card. We could not find any other choices, however, that offered either composite video input or output as part of a VGA card.

That situation is changing rapidly, and at least one manufacturer was poised to enter this market when this article went to print. USVideo of Stamford, Connecticut ((203) 964-9000), is scheduled to show its VGA-NTSC Recordable video card, which converts display information into composite video output. Unlike the Willow VGA cards, it will offer a Genlock Overlay Module that will make it possible to synchronize multiple signals for special effects and overlay images.

As the desktop presentation market grows and as more companies turn to developing their own training videos, you can expect to see more and more of your favorite programs on a TV screen near you. ■



Together, the two Willow VGA cards offer less than half of the NTSC processing capabilities of Truevision's Targa 16 video board. Like the Targa 16, the VGA-TV card can output NTSC composite signals, but it lacks the ability to overlay computer-generated signals on NTSC signals (genlock) and to output NTSC-compatible analog RGA signals. Although the Publishers' VGA board has no video output capabilities, it can capture NTSC frames—but not fields. The Targa 16 has all of these capabilities.

Also, the boards offer different palettes. While the Targa 16 offers 32,768 colors at a resolution of 512 by 482 pixels, the Willow boards offer only 256—at 800 by 600. And that's only if they're fully loaded with 512K RAM, which adds $150 to the price of the standard $699 256K boards. But even with the extra RAM, the Willow boards cost less than half the price of the $1,995 Targa 16.

Status Register, Vertical Blank Interrupt, Pan and Scroll, and Programmable Character Generator tests.

Additionally, the card cannot run in 16-bit mode on a machine using an expanded-memory manager like Microsoft's EMM.SYS, which appropriates some of the address space needed by the extra BIOS code. The result is an unreadable screen festooned with hyphens, underscores, and umlauts.

On the positive side, the documentation supplied with the board is straightforward and complete, making setup with DIP switches easy. The 800 by 600 driver for *Microsoft Windows* was easy to install and ran without incident. Other high-resolution drivers packaged with the card include diagnostics, a program to run the BIOS in system RAM, a font loader, a font editor, and drivers for *AutoCAD*, *GEM*, *Lotus 1-2-3*, *Symphony*, and *Ventura Publisher*.

PC MAGAZINE FACT FILE

Intelligent VGA Model 650
Intelligent Data Systems Inc., 6319 E. Alondra Blvd., Paramount, CA 90723; (213) 633-5504, (800) 325-2455
List Price: $399
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: OEM'd by Paradise, this 256K board is remarkable only for its inclusion of a *Microsoft Windows/386* Super VGA driver.

CIRCLE 402 ON READER SERVICE CARD

ProDesigner Plus VGA
Orchid Technology, 45365 Northport Loop West, Fremont, CA 94538; (415) 683-0300
List Price: $599
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 800 display resolution).
In Short: Average in terms of both price and performance, the ProDesigner Plus VGA is able to display 1,024 by 768 resolution and comes with special graphics utilities and high-resolution drivers for seven popular packages.

CIRCLE 403 ON READER SERVICE CARD

VGA Professional
Paradise Systems Inc., Western Digital Imaging, 800 E. Middlefield Rd., Mountain View, CA 94043; (415) 960-3360
List Price: $799
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: From one of the major VGA controller chip makers, the VGA Professional is a high-priced card offering midrange performance. It comes with a *Microsoft Windows/386* 800 by 600 driver.

CIRCLE 404 ON READER SERVICE CARD

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GENOA SYSTEMS CORP.

SuperVGA Model 5400

By Alfred Poor

The Genoa SuperVGA Model 5400 is a ¾-length card capable of displaying 1,024 by 768 resolution; it comes with 512K RAM and a $699 list price. Though it is among the more expensive boards we reviewed, it is also one of the slowest.

One interesting feature of the Model 5400, which has a Tseng Labs chip set, is that it uses only a single crystal, while other designs rely on as many as five or seven. This does not appear to harm the compatibility of the product, however. The Model 5400 performed flawlessly in the BIOS tests and had problems with only two of the register tests. It failed to initialize one of the EGA monochrome modes and was jittery during the Pan and Scroll tests (as were the majority of the tested boards). Neither of these are serious flaws.

Besides the Model 5400, Genoa offers two other VGA cards. The SuperVGA Model 5300 is as 16-bit card with 256K RAM, while the SuperVGA Model 5100 is an 8-bit card with 256K.

The Model 5400's software showed some positive features. In addition to the

VGA BOARDS: SUMMARY OF FEATURES

PC MAGAZINE

(Products listed in ascending price order)

	Toucan VGA 1024 Communication Inter-Globe	Intelligent VGA Model 650 Intelligent Data Systems Inc.	Tatung VGA Tatung Company of America Inc.	Renaissance RVGA II Renaissance GRX Inc.	SOTA VGA/16 SOTA Technology	ProDesigner Plus VGA Orchid Technology
Tested configuration	$349	$399	$439	$495	$595	$599
Video memory	512K	256K	256K	256K	512K	512K
Base price	$279	$399	$439	$495	$445	$599
Video memory	256K	256K	256K	256K	256K	512K
Video BIOS	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit
Video RAM	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit	8-bit, 16-bit	8-bit, 16-bit
VIDEO STANDARDS						
CGA	●	●	●	●	●	●
EGA	●	●	●	●	●	●
VGA	●	●	●	●	●	●
Super VGA	●	●	●	●	●	●
1,024 x 768	●	○	○	○	●	●
CONNECTORS						
9-pin	●	○	○	●	●	○
15-pin	●	●	●	●	●	●
VGA	●	●	○	●	●	●
Mouse	○	○	○	○	●	○
OUTPUT						
TTL	●	○	○	●	●	○
Analog	●	●	●	●	●	●
MAXIMUM RESOLUTION						
Graphics (pixels)	1,024 x 768	800 x 600	800 x 600	800 x 600	1,024 x 768	1,024 x 768
Text (columns x rows)	132 x 44	132 x 43	132 x 43	132 x 60	132 x 43	132 x 44
Maximum number of colors in highest-resolution mode	256 (800 x 600)	256 (640 x 400)	256 (640 x 400)	256 (320 x 200)	256 (800 x 600)	256 (800 x 600)
Total number of colors	262,144	262,144	262,144	262,144	262,144	262,144
VIDEO ROM						
Version number	8.00	014C	1.09	2.13	8.00	8.00X
Revision date	June 1988	January 1989	September 1988	November 1988	September 1988	August 1988
SOFTWARE DRIVERS						
AutoCAD	●	●	●	●	●	●
GEM	●	●	Optional ($10)	●	●	●
Lotus 1-2-3	●	●	●	●	●	●
Ventura Publisher	●	●	●	●	●	●
Windows/286	●	●	●	●	●	●
Windows/386	○	●	Optional ($10)	○	●	○
Utilities	BIOS to RAM, diagnostics, font loader, mode switching	BIOS to RAM, 8/16-bit confirm operation test, mode switching, screen saver	BIOS to RAM, CGA and HGC emulator, mode switching, screen saver	BIOS to RAM, HGC emulator, mode switching	ANSI.SYS emulator, diagnostics, memory upgrade, mode switching	ANSI.SYS emulator, BIOS to RAM, font editor, font loader, hotkey/hot zoom, mode switching

PC—Editor's Choice ●—Yes ○—No

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typical BIOS relocation utility, ANSI.SYS emulator, and mode-selection program, the card also came with a pair of programs that allow you to turn smooth scrolling of text on and off. If you have ever watched text on a DEC terminal magically glide up the screen, you can appreciate the grace that a smooth-scroll utility lends to a display.

The disks in the package also contain high-resolution drivers for the basic five applications—*Lotus 1-2-3*, *Microsoft Windows/286*, *GEM*, *Ventura Publisher*, and *AutoCAD*—as well as for *Microsoft Windows/386* and *Framework*.

On balance, however, the slower performance—likely due to Genoa's failure to support 16-bit video RAM despite the card's 16-bit size—will outweigh the other benefits for most users. And with its hefty list price, you are likely to find better values among the other cards.

HEWLETT-PACKARD CO.

HP Video Graphics Adapter

by Ken Shelby

At $670, Hewlett-Packard Company's HP Video Graphics Adapter falls into the middle of the pack in price as well as in performance. What sets it apart from the other

Peacock Plus EVGA Allstar Microsystems Corp.	VGA EM-16 STB Systems Inc.	HP Video Graphics Adapter Hewlett-Packard Co.	Tecmar VGA/AD Tecmar	SuperVGA Model 5400 Genoa Systems Corp.	VGA Wonder ATI Technologies Inc.	AST-VGA Plus AST Research Inc.	VGA Professional Paradise Systems Inc.	V-RAM VGA Video Seven Inc.
$645	$649	$670	$695	$699	$699	$758	$799	$1,099
512K	512K	512K	512K	512K	512K	512K	512K	512K
$545	$449	$445	$695	$699	$499	$599	$799	$799
256K	256K	256K	512K	512K	256K	256K	512K	256K
8-bit, 16-bit	6-bit	8-bit, 16-bit	6-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	6-bit, 16-bit
8-bit, 16-bit	8-bit, 16-bit	8-bit	8-bit, 16-bit	8-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit	8-bit, 16-bit
●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	○	●	●	●	○	○	●
●	●	○	●	●	●	○	○	○
●	●	●	●	●	●	●	●	●
○	●	●	●	●	●	○	○	○
○	○	○	○	○	●	○	○	○
●	●	○	●	●	●	○	○	○
●	●	●	●	●	●	●	●	●
1,024 x 768	1,024 x 768	800 x 600	1,024 x 788	1,024 x 768	1,024 x 768	800 x 600	800 x 600	1,024 x 768
132 x 44	132 x 44	132 x 43	132 x 60	132 x 60	132 x 60	132 x 43	132 x 43	132 x 43
256 (800 x 600)	256 (800 x 600)	256 (640 x 480)	256 (800 x 600)	256 (800 x 600)	256 (800 x 600)	256 (640 x 480)	256 (640 x 480)	256 (800 x 600)
262,144	262,144	262,144	262,144	262,144	262,144	262,144	262,144	262,144
8.00X January 1989	1.55 January 1989	2.0 June 1986	1.08 January 1989	3.13 March 1969	V3M-1.03A January 1969	1.03C June 1988	014C January 1989	1.09 September 1988
●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	○	●	●	●	●	●	●
●	●	○	●	●	●	●	●	●
●	●	○	○	●	○	○	●	●
BIOS to RAM, font editor and loader, mode switching, monitor selection, nonstandard text modes, zoom	BIOS to RAM, demo program, hotkey/hot zoom, mode switching	Font loader, video mode set program	ANSI.SYS, BIOS to RAM, diagnostics, keyboard access, mode switching, screen saver	ANSI.SYS emulator, BIOS to RAM, mode switching, smooth scroll	BIOS to RAM, diagnostics, mode switching, mouse driver, system information	BIOS to RAM, diagnostics, mode switching	BIOS to RAM, 8/16-bit confirm operation test, mode switching, screen saver	Directory utility, mode forcing, screen clearing, text mode selection

cards tested is its lack of drivers for 800 by 600 resolution.

Built around the Paradise VGA controller, the only chips on this modern-looking board that aren't surface-mounted are the INMOS digital-to-analog converter, the ROM chips that contain the BIOS code, and the 512K of 100-nanosecond video DRAM chips that are soldered to the board. A single 15-pin connector lets you attach an analog monitor, and a VGA feature connector on the card edge waits patiently for something useful to do.

The documentation that comes with the package is complete and easy to understand. Setup is readily accomplished with DIP switches on the board. The card comes with a mode-setting program, guaranteeing that you'll be able to change resolution and text modes if the software you're working with doesn't offer any. It also features a font-loading utility.

FACT FILE

Renaissance RVGA II
Renaissance GRX Inc., Cedar Park, 2265 116th Ave. NE, Bellevue, WA 98004; (206) 454-8086
List Price: $495
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: Built around Renaissance GRX's custom graphics controller chip, this inexpensive 256K card offers nearly flawless VGA compatibility

CIRCLE 406 ON READER SERVICE CARD

SOTA VGA/16
SOTA Technology, 551 Weddell Dr., Sunnyvale, CA 94089; (408) 745-1111
List Price: With 256K RAM, $445; with 512K RAM, $595.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: A full complement of connectors, including one for a bus mouse and the ability to display 1,024 by 768 resolution make the SOTA VGA/16 a bargain.

CIRCLE 407 ON READER SERVICE CARD

VGA EM-16
STB Systems Inc., 1651 N. Glenville, #210, Richardson, TX 75081; (214) 234-8750
List Price: With 256K RAM, $449; with 512K RAM, $649.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: Packaged with three disks of software, including a *Microsoft Windows/386* driver, the VGA EM-16 comes with 9- and 15-pin connectors that allow it to output TTL and analog signals. It is also able to display 1,024 by 768 resolution.

CIRCLE 408 ON READER SERVICE CARD

1,024 by 768 Resolution—8514 vs. Extended VGA

by Philip F. H. Rose

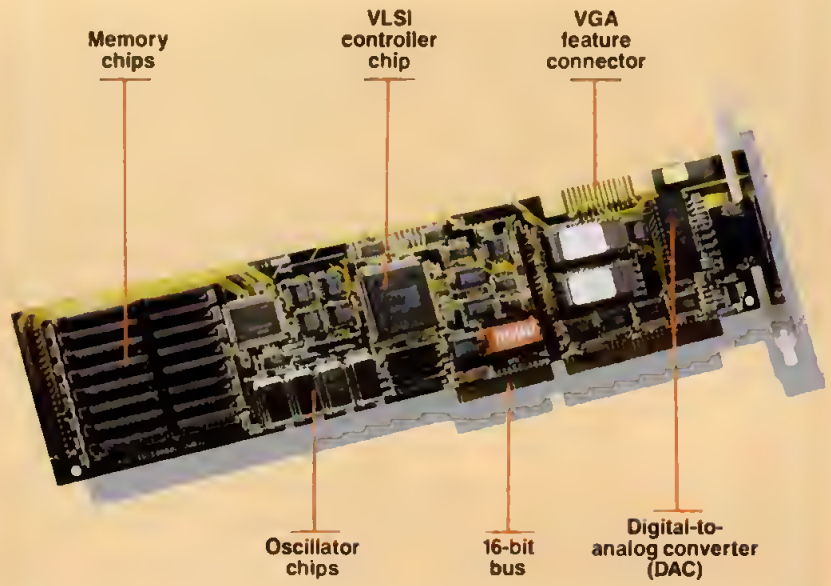
Offering 786,432 pixels at 1,024 by 768 (1K) resolution more than doubles a screen's information potential when compared with standard VGA's 307,200 pixels at 640 by 480 resolution. Nearly two thirds of the high-performance VGA cards we reviewed were able to display this impressively high resolution. It also happens to be the same high-resolution figure that IBM's far more costly 8514/A Graphics Adapter offers. But just because these boards are able to display a 1,024-by 768-pixel matrix doesn't mean they are 8514/A-compatible. In fact, none of them are.

These extended VGA boards are incompatible with 8514/A because the 8514/A is designed to work with the Micro Channel bus and because it uses a built-in graphics coprocessor. All of the cards we reviewed work with the AT bus, and none of them have graphics coprocessors. (The Video Seven V-RAM VGA does offer an on-board video memory cache, called FastWrite, that should give it some of the performance gains of a coprocessor.)

Besides being incompatible, the extended VGA boards and the 8514/A create their respective 1K resolutions differently. The 8514/A produces an interlaced display, which means that it generates images by scanning across alternate lines of the screen, requiring two passes to produce a whole image. At least some of the VGA-based boards are capable of generating a noninterlaced 1,024 by 768 image, which is

TWO WAYS TO DISPLAY 1,024 x 768

The major difference between the 8514/A adapter and extended VGA boards such as the Video Seven V-RAM VGA is the Micro Channel 8514/A's coprocessor chip. Since extended VGA boards lack such a chip—and since they were designed to work with the AT bus—they are incompatible with 8514/A, though both types of video graphics adapters are able to display 1,024 by 768 resolution.



produced in a single pass because each line is traced in succession. While monitors that display noninterlaced images cost considerably more than their interlaced counterparts, the superiority of the image quality produced by a noninterlaced image is undeniable.

The 8514/A can generate more colors at 1K resolution. Outfitted with 512K, an extended VGA board capable of displaying 1,024 by 768 will give you 16 colors in that mode, the same number you would get with a standard 8514/A adapter. However, with added 512K RAM memory, the 8514/A can display 256 colors, a feat beyond the capabilities of the VGA cards, whose board real estate is exhausted by 512K worth of video RAM chips. But if you do need 256 colors, the 512K-equipped VGA boards can give them to you at 800 by 600 resolution.

THE COPROCESSOR'S ROLE

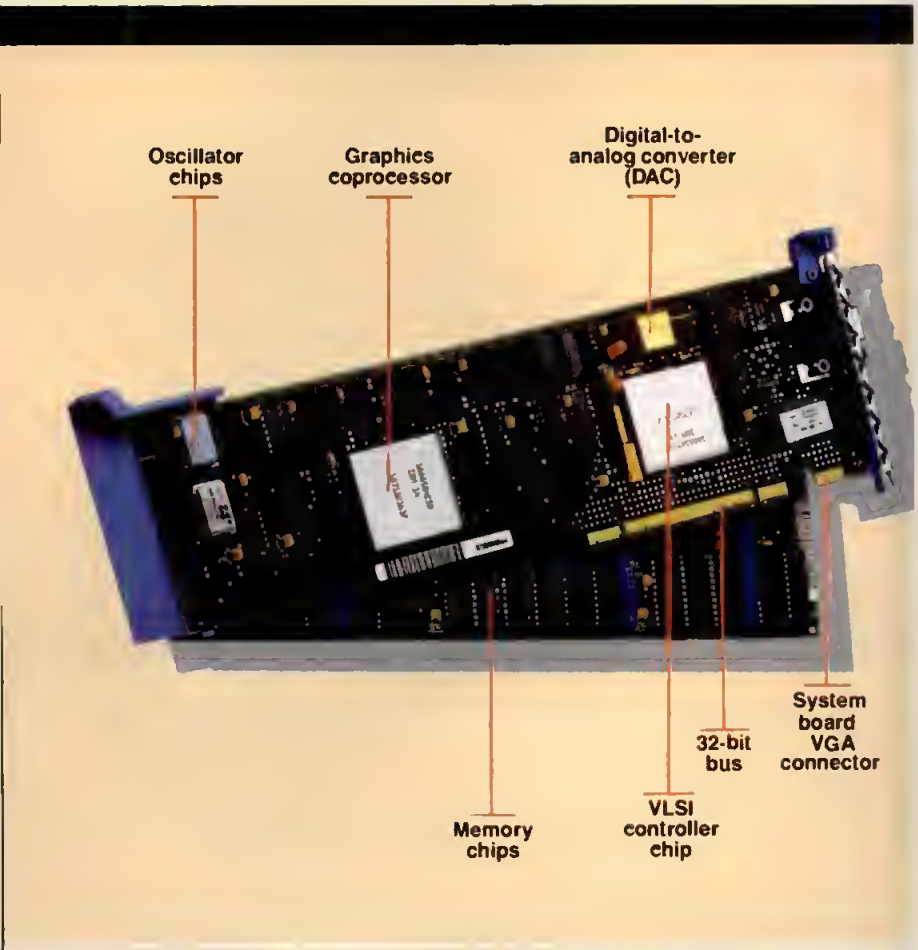
The graphics coprocessor at the heart of the 8514/A is the key to its appeal. With the coprocessor, the board is able to move graphics processing off the main system microprocessor. By off-loading the creation of graphics from the main system microprocessor to the graphics board, you can achieve faster performance (as much as three times that of standard VGA) and added flexibility through the Application Interface.

With the chip's command language, you can describe graphics primitives, such as rectangles and lines, with a few coordinates rather than with complete bitmaps. This procedure saves time, especially in CAD operations. Besides enhancing graphics performance, it frees the main processor almost immediately, allowing it to pursue other operations once instructions have been passed to the graphics processor. In a multitasking environment, where there is less time when system resources are not in use, this off-loading could affect system performance substantially.

While off-loading can be advantageous at the DOS prompt and with text-based applications like *WordStar*, it is especially useful in windowing environments, such as *Microsoft Windows* and *Presentation Manager*. It makes multiple window operations more practical, especially when paired with a 16-inch monitor.

This January, Compaq introduced another 1K-capable adapter. Compaq's Advanced Graphics 1024 board has more in common with the IBM 8514/A Graphics Adapter than it does with an enhanced VGA card. Like the IBM, it coexists in your system with standard VGA. When support for a VGA or lower video mode is called for, the VGA board handles it directly. Only when the 1,024- by 768-pixel resolution modes are requested does the Compaq board kick in.

The Compaq AG1024 uses a graphics coprocessor, the Texas Instruments 34010, to off-load work from the system microprocessor; it also supports *Windows* and *AutoCAD*. Like the Video Seven V-RAM VGA card (but not like IBM's 8514/A Graphics Adapter), Compaq's board is not interlaced.



IS THE 8514 AN ADVANTAGE?

While writing graphics primitives to the 8514 processor is great for CAD, it is not always faster than the good old bitmap method. In fact, Presentation Manager will bypass the Application Interface completely.

It is unclear at this point whether the 8514 will become an industry standard. If it does, then you may find more products supporting the 1,024 by 768 mode of the 8514/A than that of other cards. Whether it does or not, the support for *Windows*, *AutoCAD*, and other applications offered by the Compaq Advanced Graphics 1024 board and the enhanced VGA cards may be all you'll need. ■

Philip F. H. Rose is a project leader at PC Labs.

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40MB/40ms	$1,379	$1,679	$1,879

286/10 $745

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- Harris 80286- 16 CPU running at 8/16MHz (keyboard switchable)
- 512K RAM, expandable to 8MB on system board
- 0 wait state w/ page mode interleaved arrangement
- Shadow RAM for system & video BIOS relocation
- Five 16-bit & three 8-bit slots
- 200 watt UL, CSA & TUV approved power supply (110V/220V)
- ROM-Based setup
- Supports EMS/LIM 4.0
- Supports 80287 math coprocessor
- Choice of 1.2MB or 1.44MB floppy disk drives
- 1:1 interleaved hard/floppy disk drive controller
- Parallel & serial ports
- Enhanced 101-key keyboard
- ACMA 286 utility software

$995

	Mono	EGA	VGA
40MB/28ms	$1,549	$1,919	$2,089
80MB/28ms	$1,795	$2,165	$2,335

286 /20 $1,095

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- Intel 80386-20 CPU running at 16/20MHz (Keyboard switchable)
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- 0 Wait State w/ page mode Interleaved arrangement
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- 200 watt UL, CSA & TUV approved power supply (110V/220V)
- ROM-based setup
- Extended BIOS functions to enable or disable shadow RAM, EMS & interleaved mode
- Choice of 1.2MB or 1.44MB floppy disk drives
- 1:1 interleaved hard/floppy disk drive conntroller
- Parallel & serial ports
- Enhanced 101-key keyboard
- ACMA 386 Utility Software

$1,595

	Mono	EGA	VGA
40MB/28ms	$2,149	$2,519	$2,689
80MB/28ms	$2,395	$2,765	$2,935

ACMA 386/25

Business System

- Intel 80386-25 CPU running at 16/25MHz (Keyboard switchable)
- 1MB 32-bit high-speed RAM, expandable to 16MB (8MB 32-bit on system board)
- 0 Wait State w/ page mode Interleaved arrangement
- Shadow RAM for system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports Weitek, 80387 & 80287
- Two 32-bit, four 16-bit & two 8-bit expansion slots
- 200 watt UL, CSA & TUV approved power supply (110V/220V)
- ROM-based setup
- Extended BIOS functions to enable or disable shadow RAM, EMS & interleaved mode
- Choice of 1.2MB or 1.44MB floppy disk drives
- 1:1 interleaved hard/floppy disk drive controller
- Parallel & serial ports
- Enhanced 101-key keyboard
- ACMA 386 Utility Software

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	Mono	EGA	VGA
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80MB/28ms	$2,695	$3,065	$3,235

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- Supports 8087 math coprocessor
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- 84-key keyboard

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	Mono	EGA	VGA
20MB/65	$925	$1,295	$1,465

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- Enhanced 101-key keyboard
- Supports 80287 math coprocessor

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Monitors

Samsung Full-Page & Video Card *(for IBM, Mac II & Mac SE)*	***$615***
Samsung 14" CGA	$219
Samsung 14" EGA	$325
Samsung 14" VGA	$365
Samsung 14" SyncMaster	$425
NEC Multisync - 2A	$499
NEC Multisync - 3D	$645

Video Cards

ACMA mono	$45
ACMA CGA	$45
ACMA EGA 640x480	$125
VGA-16 by Paradise	$295
Video-7 VEGA VGA	$275

I/O Cards

286 I/O (S/P/G)	$45
286 HD/FD controller	$109

Hard Drives

Toshiba (Novell Certified):

44MB/25ms	$425
72MB/25ms	$595
150MB/25ms	$1,195
Segate	Call
Miniscribe	Call

Floppy Drives

360K	$75
720K, 1.2MB or 1.44MB	$85

Printers

Panasonic 1080	$179
Panasonic 1124	$339
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PERFORMANCE TESTS: VGA COMPATIBILITY

	VGA SOFTWARE COMPATIBILITY									VGA HARDWARE COMPATIBILITY					
										VGA WRITE MODES					
	Color Bars	Character Set	Character Attributes	Line Pattern	DAC Palette	Direct Writes to Frame Buffer	Direct Palette Access	Normal	From Latches	Fast Color Fill	Set/Reset	Rotated 4	AND	OR	XOR
Tatung VGA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Peacock Plus EVGA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Intelligent VGA Model 650	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
VGA Professional	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
VGA Wonder	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
HP Video Graphics Adapter	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P
AST-VGA Plus	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P
Toucan VGA 1024	P	P	P	P	P	P	P	P	P	P	P	F	F	F	F
SOTA VGA/16	P	P	P	P	P	P	P	P	P	P	P	F	F	F	F
Tecmar VGA/AD	F	P	P	P	F	P	P	P	P	P	P	F	F	F	F
VGA EM-16	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P
ProDesigner Plus VGA	P	P	P	P	P	P	P	P	P	P	P	F	F	F	F
V-RAM VGA	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
SuperVGA Model 5400	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P
Renaissance RVGA II	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P

P—pass, F—fail.

Of all the boards tested for VGA compatibility, only the Renaissance RVGA II came through our entire suite of VGA compatibility tests unscathed. Not only did it pass the software (BIOS-level) tests, it was also the first VGA board we have tested that passed every one of the hardware (register-level) tests. The RVGA II's high degree of compatibility is due to its Cirrus Logic chip set; none of the other tested display adapters used this chip set.

All of the boards, except for the Tecmar VGA/AD, passed the software compatibility tests. The VGA/AD had trouble with the Color Bars and DAC Palette tests, failing to display the colors associated with both tests.

Apart from the Renaissance RVGA II, each of the boards failed at least one of the hardware compatibility tests. Failure of any one test does not invalidate a card's VGA utility; it merely indicates that the card does not meet IBM's PS/2 VGA specification completely. Most commercial software should run on cards failing one or two of the tests. But cards that are not 100 percent compatible with the PS/2 VGA specification will have problems with some software somewhere down the line.

The 15 boards tested used VGA chip sets from Tseng Labs, Paradise Systems, Video Seven, ATI Technologies, and Cirrus Logic. The boards using the Tseng Labs chip set displayed the widest variance of failures, ranging from one failure by Allstar Microsystems Corp.'s Peacock Plus EVGA to ten failures by the Tecmar VGA/AD. The rest of the boards had only one or two failures, indicating that all of these chip sets are good starting points for a VGA controller.

The worst-performing board overall was the Tecmar VGA/AD, which failed 10 of our 21 compatibility tests. Its poor performance is offset by the wide range of high-resolution software drivers provided with the board. You should check its compatibility with the software you are planning to run on it before you buy.

In addition, all of the boards were tested with *Microsoft Windows/386* running as regular VGA. All were able to load *Windows/386*, run a text application within a window, and run while switching to a non-*Windows* graphics application in the background.

VGA SOFTWARE COMPATIBILITY

The VGA Software (BIOS-level) Compatibility test group deals with VGA mode 19: 320 by 200 resolution by 256 colors. The five tests involved are:

Color Bars. This test displays the entire 256-color spectrum that VGA is capable of producing.

Character Set. This procedure displays the entire IBM character set (256 characters) on a 40-column screen in both normal and high-intensity white.

Character Attributes. This test displays the hexadecimal characters 0 through Fh using the same color shadings found in the Color Bars test.

Line Pattern. This test draws an octagon, with the darkest colors in the middle and the lighter, more pastel colors blending toward the outside.

DAC (digital-to-analog converter) **Palette.** This test draws the colors red, green, blue, and gray in 64 shades each, starting at the darkest level and moving to the lightest.

VGA COMPATIBILITY

Hardware compatibility with the IBM VGA standard is determined by addressing the six sets of registers in IBM's PS/2 VGA video subsystem. The tests are performed on an IBM PC AT 339, with the results measured against the PS/2 motherboard implementation of VGA on a pass/fail basis. The following register areas are covered.

The **general registers** include a status register, which is used to tell the system whether video information is being displayed or a vertical retrace of the CRT's gun is being performed. The status register can be programmed so that the system microprocessor may be interrupted during a vertical retrace, and it can request system resources for the display.

The **DAC register** controls the digital-to-analog converter. This converter takes the digital video output from the VGA's attribute controller and converts the signals to analog form.

The **attribute registers** are responsible for the attribute controller, which is part of the VGA controller chip. The attribute controller is responsible for formatting the information in video memory for output to the DAC and subsequently to the display.

The **CRT controller** (CRTC) **registers** generate the timings for horizontal and vertical swaps of the CRT gun. These registers include a vertical blank interrupt (VBI) register. The CRTC also allows for split-screen operations and for panning and smooth scrolling of on-screen images.

The **sequencer registers** generate the timings for video RAM refresh and control the character map and character attributes.

The **graphics registers** handle the graphics controller, another element of the VGA controller chip. The graphics controller is the interface between the attribute controller and video memory during screen display. It converts parallel memory data to serial bit plane data and sends it to the attribute controller. It is also the interface between the system microprocessor and video memory during memory write/read operations. The graphics controller can perform logical operations on the data as it moves between system RAM and display RAM.

VGA HARDWARE COMPATIBILITY

The VGA Hardware (register-level) Compatibility test suite is composed of eight individual tests:

Direct Writes to Frame Buffer. This test writes directly to the display's video RAM using 15 display modes of VGA. This procedure tests the system's ability to manipulate the VGA graphics controller, allowing direct memory access to the video RAM.

Direct Palette Access. This test cycles through the colors of the display by directly controlling the DAC.

VGA Write Modes. This test deals with two areas of the VGA controller chip: the graphics controller and the attribute controller. The top half of the screen is a graphics controller test in which the results of the different VGA write modes are displayed. The bottom half of the screen tests the attribute controller's plane enable write registers.

Status Register. This test checks the vertical blank bit contained in the set of general registers and compares it to the clock on the VGA board.

Programmable Character Generator. This tests the VGA's ability to deal with a programmable character set, which is the domain of the sequencer in the VGA chip. The entire IBM character set appears upside down in the middle of the screen.

Vertical Blank Interrupt. This procedure compares the clock time on the display board to the tick count from the interrupt handler in the VGA controller.

Pan and Scroll. This test deals with the CRT controller's pan-and-scroll abilities. This test scrolls text on the screen up and to the left smoothly.

Split Screen. Another test of the CRTC, this procedure fills the screen with happy faces, then splits the screen and smooth-scrolls the text "This Text Should Be Scrolling Up The Screen" all the way to the top.

Testing VGA compatibility at the BIOS level revealed the same minor problems that many other cards had with the PC Labs Color Bars and Character Attributes tests. At the register level, the HP Video Graphics Adapter was not able to initialize modes 7 and 15 during the Direct Writes to Frame Buffer test. More importantly, its failure in the Status Register and Vertical Blank Interrupt tests indicate that it will have trouble with advanced graphics programs that make use of these features. This board did quite well, however, on the test that writes directly to the video memory (Direct to Screen test) and performed with average success when writing through the BIOS.

Although a 640 by 480 16-color driver for *Microsoft Windows*, Version 1.03, was included in the package, the board lacked an 800 by 600 16-color driver for *Microsoft Windows/286* or *Windows/386*. It does come with Super VGA drivers for *AutoCAD*, *CADvance*, *Lotus 1-2-3*, *GEM*, and *VersaCAD*.

PC MAGAZINE FACT FILE

Tatung VGA
Tatung Company of America Inc., 2850 El Presidio St., Long Beach, CA 90810; (213) 979-7055
List Price: $439
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: Fast and low-priced, this half-length card comes with five free drivers; *Microsoft Windows/386* and *GEM* drivers are available on one disk for $10.

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Tecmar VGA/AD
Tecmar, 6225 Cochran Rd., Solon, OH 44139; (216) 349-1009
List Price: $695
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: With 11 high-resolution drivers and 9-pin, 15-pin, and VGA feature connectors, the Tecmar VGA/AD's performance is above average.

CIRCLE 410 ON READER SERVICE CARD

V-RAM VGA
Video Seven Inc., 46335 Landing Pkwy., Fremont, CA 94538; (415) 656-7800
List Price: With 256K RAM, $799; with 512K RAM, $1,099.
Requires: 286 or 386 AT-compatible computer, VGA monitor (multiscanning monitor required for 800 by 600 display resolution).
In Short: The V-RAM VGA's speed is impressive, but not enough to make up for its ridiculously high price.

CIRCLE 411 ON READER SERVICE CARD

INTELLIGENT DATA SYSTEMS INC.

Intelligent VGA Model 650

by Ken Shelby

For $399, Intelligent Data Systems offers a plain-vanilla 256K board with midrange speed. And if you're a Paradise fan, take note: the Intelligent VGA Model 650 board appears to be identical to the Paradise VGA Plus 16 card (which we looked at but didn't officially review).

The differences between the Model 650 and the Paradise card were minor: under the small "IDS" sticker covering its Paradise VGA controller chip, the Model 650 has "rev x4" silk-screened; the silk screen on the Paradise VGA Plus 16 reads "rev x3." The two boards performed absolutely identically. In fact, either board will run the software that is supplied with the other. And the documentation supplied with the IDS board was also obviously from Paradise.

This card looks well laid out, with lots of surface-mount chips in evidence. Its 256K of 100-nanosecond video DRAM is soldered on-board, and it contains a 15-pin analog monitor connector along with a VGA feature connector. Setup is through DIP switches. Programs bundled with the card include a driver to shadow the video BIOS in main system RAM, diagnostics, and a program to switch the board between the various VGA modes.

Like several other boards, the Model 650 has some BIOS-level compatibility problems, as shown by its failure on the Color Bars and Character Attributes tests. The only hardware problems involved the Status and Vertical Blank Interrupt registers. Its failure on the Status Register test indicates that the board will be likely to have problems with advanced graphics programs. The Vertical Blank Interrupt test results, while not relevant to the bulk of current applications, may pose problems in the future as developers make greater use of this register to implement flicker-free screen updates. The video benchmark and *Microsoft Windows* performance test results were about on a par with other boards tested.

The Intelligent VGA Model 650 comes with all the Super VGA drivers that Paradise cards do, including *Microsoft Windows/386*.

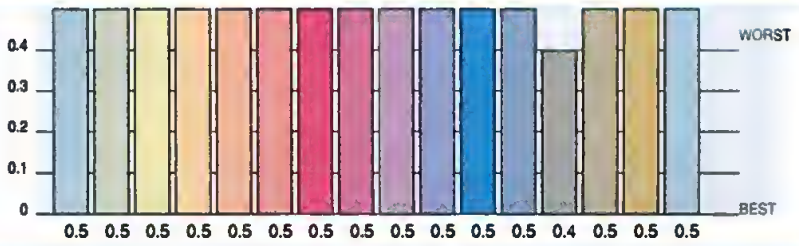
PERFORMANCE TESTS: VGA CARDS

PC Labs tested 15 VGA controller boards with 16-bit interfaces in both text and graphics modes. We have included the results of the IBM PS/2 Model 60's built-in VGA for comparison. All boards were tested in a 16-bit slot of an IBM PC AT 339 with 640K of conventional memory using DOS 3.3. All graphics tests were performed at 600 by 600 resolution using the manufacturer's provided Super VGA driver for *Microsoft Windows/286*, Version 2.1. The *Windows* tests were performed in a window 60 columns wide and 20 rows deep to keep the tests comparable from card to card. The results indicate the VGA boards' relative performance in the *Windows* graphics environment.

Line Two

Elapsed Time (seconds)

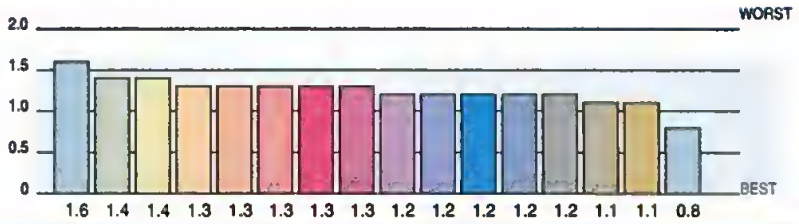
The **Line Two** function test measures the time it takes to draw 100 random lines of various colors.



Rectangles

Elapsed Time (seconds)

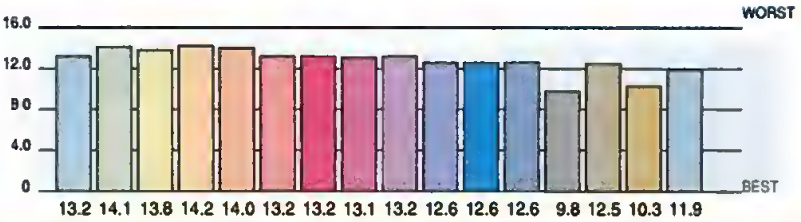
The **Rectangles** test measures the time it takes to draw ten rectangles of random size and color.



Ellipses

Elapsed Time (seconds)

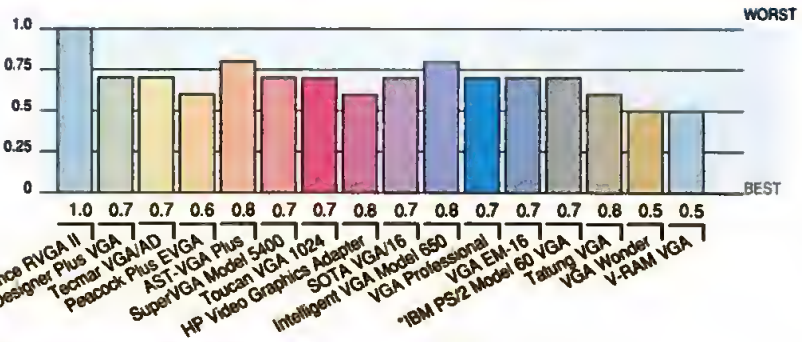
The **Ellipses** test measures the time it takes to draw 100 ellipses of random size and color.



Bitblt

Elapsed Time (seconds)

The **Bitblt** (Bit Block Transfer) test measures the time it takes to draw 100 rectangles of the same size and color.

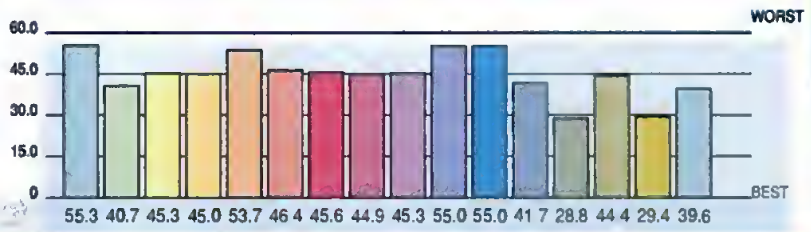


* This product was not reviewed, but we are reporting its test results for comparison.

Stretchblt

Elapsed Time (seconds)

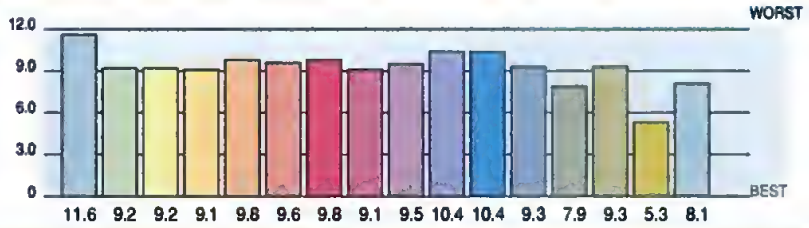
The **Stretchblt** (Stretch Block Transfer) test measures the time it takes to draw 100 copies of a rectangle with varying sizes but the same color.



Scrollwindow

Elapsed Time (seconds)

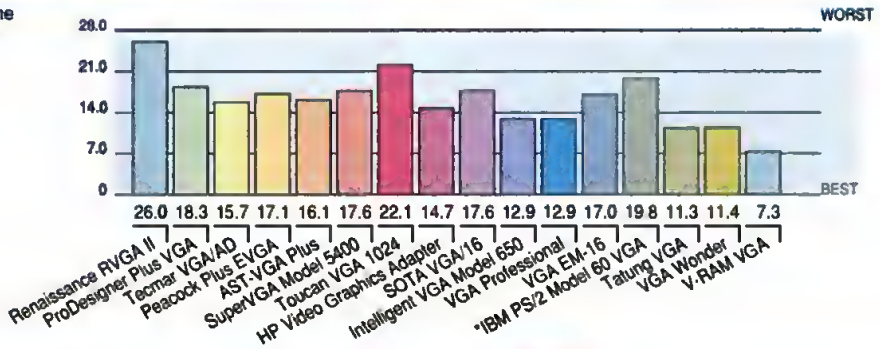
The **Scrollwindow** test creates a rectangle 1/10 the height and 1/10 the width of the window in the upper-left-hand corner of the screen and measures the time it takes to scroll across the window to the right, down, and diagonally to the upper left of the window, pixel by pixel.



Fill Rect

Elapsed Time (seconds)

The **Fill Rect** test measures the time it takes to fill the window 512 times with varying colors.

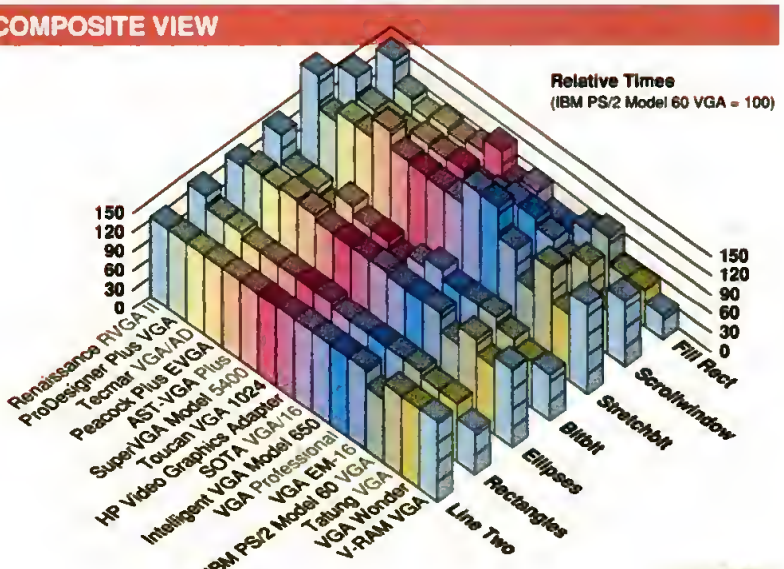


PERFORMANCE TEST RESULTS: COMPOSITE VIEW

In the *Windows* performance tests, as in the video benchmark tests, ATI Technologies' VGA Wonder and Video Seven's V-RAM VGA were at the head of the class, with the Tatung VGA board running third. STB Systems' board—the VGA EM-16—also performed well, its *Windows* driver elevating its graphics performance to a level that approaches the leaders on this test.

The IBM PS/2 VGA and the HP Video Graphics Adapter were tested at standard VGA resolutions using the standard *Windows* drivers for VGA. The PS/2 VGA has no support for Super VGA resolution, while HP does not furnish an 800 by 600 driver for *Windows*.

* This product was not reviewed, but we are reporting its test results for comparison.



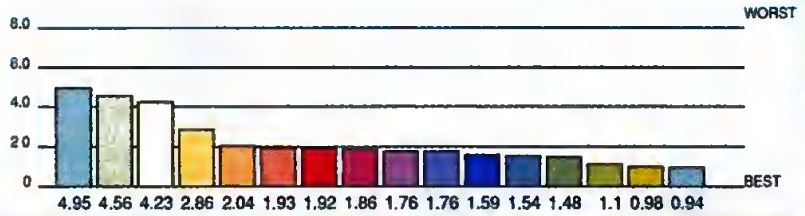
(CONTINUES)

BENCHMARK TESTS: VGA CARDS

Video BIOS Routine Without Scrolling

Elapsed Time (seconds)

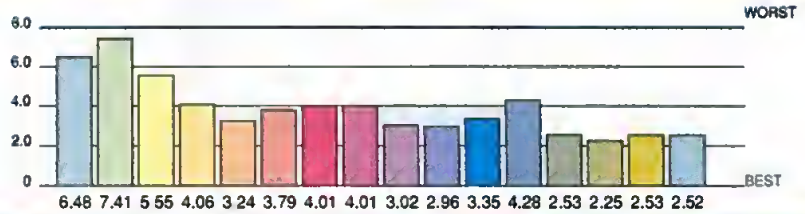
The Video BIOS Routine Without Scrolling benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



Video BIOS Routine with Scrolling

Elapsed Time (seconds)

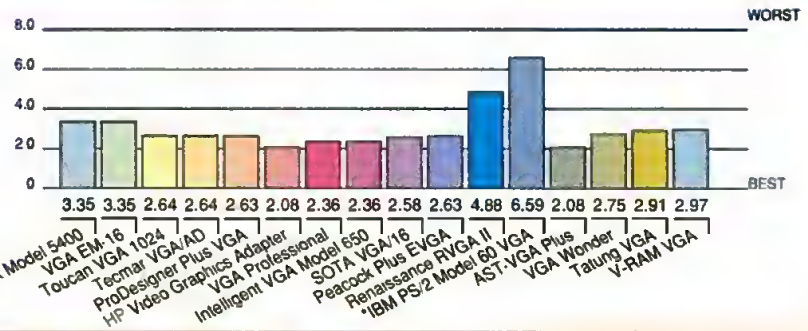
The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



Direct to Screen

Elapsed Time (seconds)

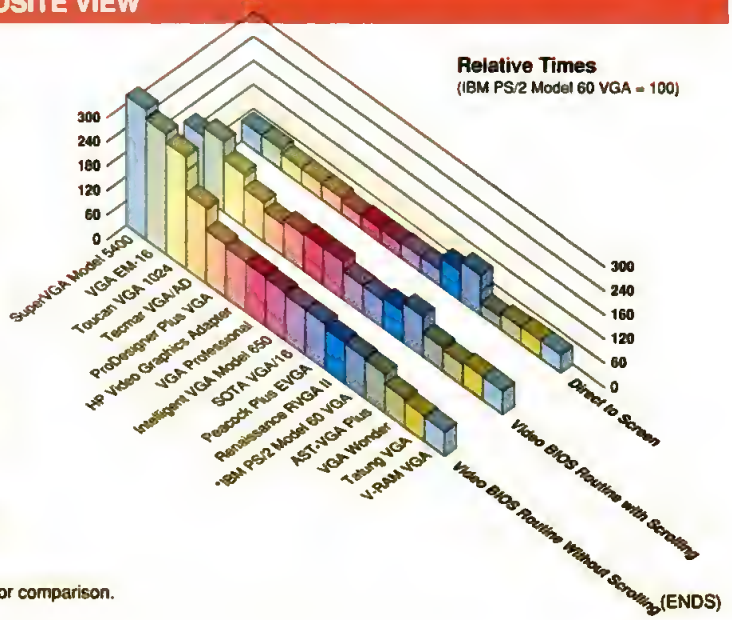
The Direct to Screen benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



BENCHMARK TEST RESULTS: COMPOSITE VIEW

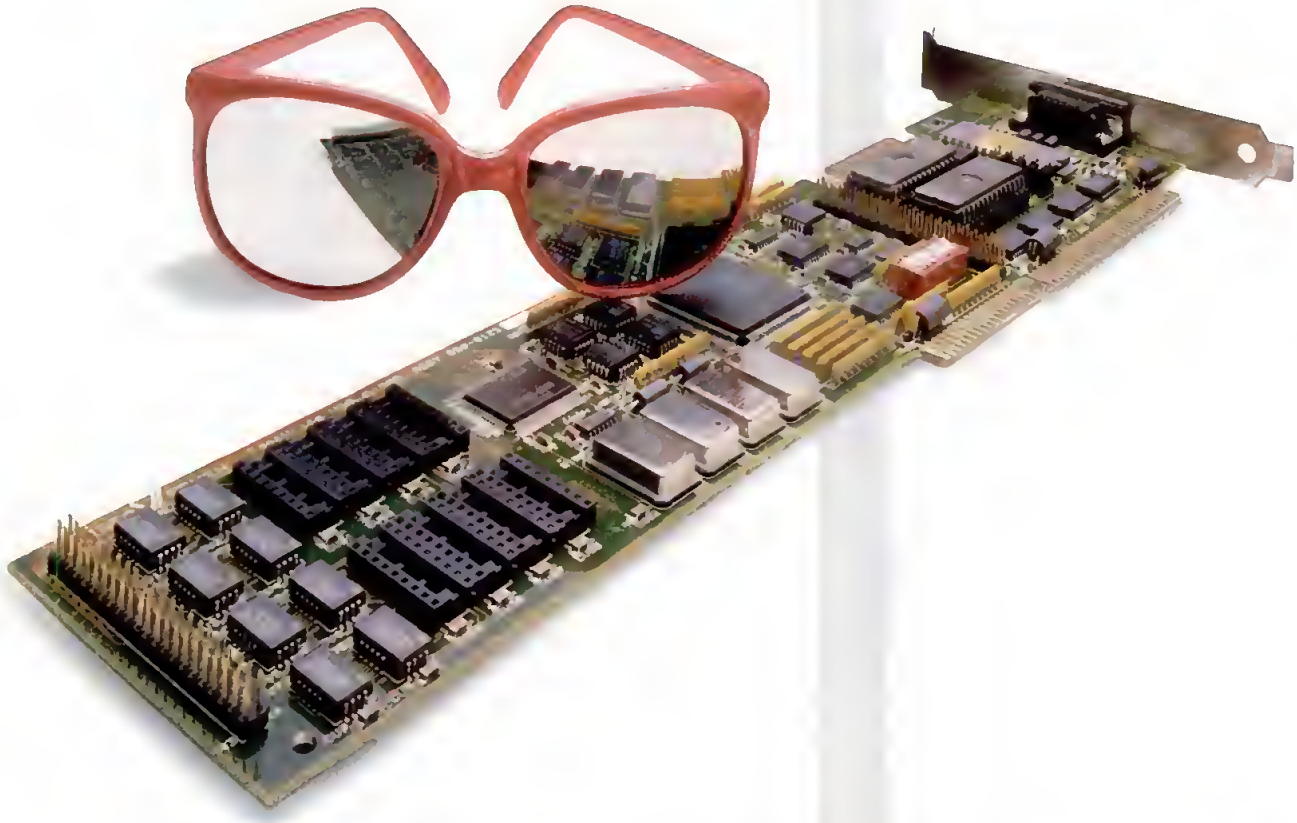
The top three boards in this roundup prove that there is more then one answer to high-performance VGA. The top honors in the video benchmark tests go to the ATI Technologies board, the VGA Wonder, with credit to its proprietary VGA controller for its performance. Video Seven comes in second, with its use of dual-ported VRAM in the V-RAM VGA board, end Tatung is right behind, the Video Seven controller in its Tetung VGA keeping it in the hunt. All three boards outdistanced the built-In VGA of the PS/2 Model 60, which uses an 8-bit controller running in e 10-MHz machine for the video benchmark tests.

Bringing up the reer are products from Genoe Systems Corp., STB Systems, end Communication Inter-Globe (the SuperVGA Model 5400, VGA EM-16, and Toucan VGA 1024, respectively). The numbers for the Video BIOS Routine tests indicate 8-bit BIOS functioning. When tested in an 8-bit slot, the Genoe end Inter-Globe boards ran slower still, whlle STB's performed the same. This implies inefficient BIOS coding on the part of Genoa end Inter-Globe. The STB boerd runs its BIOS et only 8 bits. Nevertheless, all these boards do run the displey memory in e 16-bit-wide deta path.



* This product was not reviewed, but we are reporting its test results for comparison.

Some People Buy FastWrite VGA™ For Its Blinding Speed.



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CIRCLE 127 ON READER SERVICE CARD

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ORCHID TECHNOLOGY

ProDesigner Plus VGA

by Alfred Poor

Long, low, and lean, Orchid Technology's ProDesigner Plus VGA gives you high resolution with a low profile. At a list price of $599, this full-length board will give you displays of up to 1,024 by 768 resolution and midrange performance.

The board is less than 3 inches tall, making it easy to fit into XT and small-footprint cases. The limited amount of board real estate is part of the reason that the card offers only a 15-pin analog port. But the ProDesigner Plus is one of the easiest cards to configure and install; it has only two jumpers and no switches.

The ProDesigner Plus is built around the Tseng Labs VLSI chip. The card also sports three separate BIOS ROM chips and five different crystals. The 512K of memory comes in the form of 100-nanosecond chips that are soldered in place. Overall the board has a fairly clean design, thanks to its extensive use of surface-mount chips. There is only one extra wire on the back of the card, indicating minimal last-minute design changes. Orchid also offers two other VGA cards. The Designer VGA is an 8-bit card with 256K RAM; the ProDesigner VGA is a 16-bit card with 256K.

The ProDesigner Plus is one of the least expensive 512K boards that you can buy.

The ProDesigner Plus performed well in the PC Labs compatibility tests, having only a few register-level flaws. The most significant was a jumpy response to the Pan and Scroll test, which is a problem shared by the majority of the cards tested here. The benchmark test times were uniformly average compared with those of the competition.

The ProDesigner Plus comes with 800 by 600 drivers for *Microsoft Windows/286*, *Ventura Publisher*, *Lotus 1-2-3*, *AutoCAD*, and other popular programs. It also includes some handy utilities, such as small text fonts and a screen font editor, a BIOS relocation program, and an ANSI.SYS-type emulator. In addition, the card came with Hotkey and Hotzoom, a handy pair of utility programs that allow you to zoom in on a graphics display, then pan around to examine different areas in close-up detail.

The ProDesigner Plus is one of the least expensive 512K boards you can buy, and when you factor in its respectable benchmark test performance, it comes out as one of the more attractive values in the field.

PARADISE SYSTEMS INC.

VGA Professional

by Ken Shelby

At $799, Paradise Systems' VGA Professional is a high-priced card offering midrange performance. Surprisingly, it lacks the ability to display 1,024 by 768 resolution, which is offered by nearly two-thirds of its competitors. It does offer a wide selection of Super VGA drivers, including one for *Microsoft Windows/386*.

Owned by Western Digital, one of the larger microcomputer chip manufacturers, Paradise is one of the major VGA controller chip set makers; as you would expect, the chip on this board is a Paradise unit.

Paradise's line of VGA cards also includes the 8-bit, 256K Paradise VGA Plus. The VGA Professional circuits are neatly laid out, with only surface-mount chips used. A 15-pin analog monitor connector and a VGA feature connector accompany the card. Setup is accomplished via four DIP switches. Utility programs bundled with the card include a device driver to run the video BIOS in main-system RAM, diagnostics, and a program to switch the board between the various VGA modes.

Like several other boards, the VGA Professional has some BIOS compatibility problems, as shown by its failure on both the Color Bars and Character Attributes tests. The card also failed the Status and Vertical Blank Interrupt tests. While not strictly relevant to most current applications, these shortcomings may pose problems in the future as developers use these registers to request system resources for screen updates. The video benchmark and *Windows* performance tests placed the VGA Professional in the middle of the pack in speed.

High-resolution Super VGA drivers are included for *AutoCAD*, *CADvance*, *Framework II*, *GEM*, *Generic CADD*, *Lotus 1-2-3*, *Ventura Publisher*, *VersaCAD*, *Microsoft Windows/286* and */386*, and *WordPerfect*.

RENAISSANCE GRX INC.

Renaissance RVGA II

by Alfred Poor

Some folks play follow the leader, while others prefer to set their own course. The $495 Renaissance RVGA II from Renaissance GRX is an example of independent thinking, most of it laudable.

Renaissance specializes in graphics products, and the RVGA II actually represents one of the lower-end items in its lineup, which also includes the Renaissance RVGA, an 8-bit 256K card. Among the high-end graphics video adapters designed and produced by Renaissance is the new AG1024 built for Compaq.

The two-thirds-length RVGA II prominently features a pair of VLSI chips from Cirrus Logic; it is the only board to sport a chip set from that maker. It has three crystals and carries 120-nanosecond RAM chips soldered in place. Unlike most of the other cards in this review, the RVGA II comes with only 256K; there is no 512K model. (This limits the number of colors that can be displayed in a given mode, but the card can still produce 16 colors in 800 by 600 resolution, enabling it to display Super VGA.) There is but one jumper on the card, and configuration is handled with a bank of eight switches that can be reached through the end mounting bracket. The bracket also offers both 9-pin digital and 15-pin analog ports.

In fact, the RVGA II's design is impressive in all areas save one: its failure to support 16-bit video RAM. The card's unimpressive speed—its performance on the video benchmark and *Windows* performance tests placed it on the low side of the midrange—is likely due to this lack.

The card did turn in a nearly flawless run on the compatibility tests. The only

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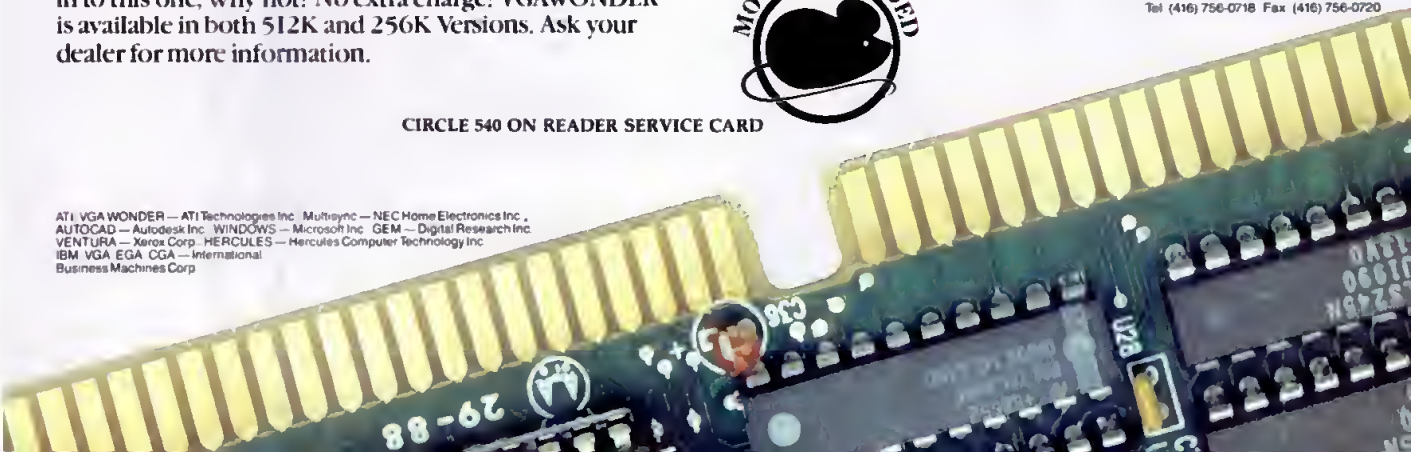

snag was that the *Windows* Fill test did not work properly: the colors jumped as the display hit discontinuous points in the shading instructions. The problem was in the *Windows* driver, and it is a tribute to the company's programming staff that a beta version update that arrived the next day took care of the problem. According to a Renaissance representative, the problem had never been reported before, making the overnight fix all the more impressive. The only other hitch was that you must run a special parameter driver to get the *Windows* driver to work with an NEC MultiSync II monitor.

The benchmark test results were mixed, with the *Windows* times on the slow side of average. This is due in large part to the 800 by 600 *Windows* driver; you should expect to see average results for other applications, which include all the usual packages (*AutoCAD*, *GEM*, *Lotus 1-2-3*, and *Ventura Publisher*) and *Symphony*, but not *Windows/386*.

According to the company spokesman, the card offers some extra advantages. For example, the VGA feature adapter can be used with the card under all modes, which is not the case with some of its competitors. The feature adapter could become an important item in the future because it permits pass-through access for the VGA to a high-resolution display attached to a separate graphics coprocessor board (such as the new Compaq product).

Aside from the problems with the *Windows* driver, the RVGA II proved to be a solid product at an attractive price. It has the earmarks of good engineering, including flawless VGA compatibility, and represents a good value.

SOTA TECHNOLOGY

SOTA VGA/16

by Ken Shelby

Offering a variety of options, including 9-pin TTL, bus mouse, and feature connectors—as well as the ability to display 1,024 by 768 resolution—this $595 512K VGA board from SOTA (an acronym for State of the Art) is a good deal.

SOTA builds its VGA/16 board around a Tseng Labs controller chip, which is the sole surface-mount chip on the board. Both the standard 256K of 100-nanosecond video DRAM (which sells for $445) and the optional upgrade to 512K reside in sockets. The card comes with a font loader, a font editor, and seven fonts, as well as a diagnostics program, a device driver to run a copy of the video BIOS from main system RAM, and a mode-switching program.

Like ATI Technologies' VGA Wonder, which also uses the Tseng Labs controller chip, the SOTA card failed the Vertical Blank Interrupt and the Pan and Scroll tests, indicating that sophisticated graphics programs will probably have some trouble with both flickering and jumpy scrolling.

Unfortunately, the SOTA card also failed those portions of the VGA Write Modes test that probe the card's ability to handle logical operations on video data: Rotated 4, AND, OR, and XOR. And, like several other cards, it failed the BIOS-level Color Bars and Character Attributes tests. None of these test failures should make the board unusable, though they may indicate that it will have minor problems with some software packages.

Like the VGA Wonder, which also uses the Tseng Labs controller chip, the SOTA card failed some tests, indicating that it will have trouble with some graphics programs.

The speed tests showed that the VGA/16's BIOS is faster than average, but it was a bit slow when writing directly to the display buffer. The card lacks a *Microsoft Windows/386* driver, but it does come with the five basic drivers and one for *Symphony*.

Its bus mouse connector alone makes the SOTA VGA/16 special; combined with its solid performance, wide range of options, and low price, the VGA-16 adds up to an impressive product.

STB SYSTEMS INC.

VGA EM-16

by Alfred Poor

The VGA EM-16 is a two-thirds-length card that lists for $649 with 512K, which places it about in the middle of the pack. While it offers a wider range of features than the bulk of its peers, this VGA card's performance on our video benchmark tests appears to conflict with the phrase from which its maker's name is derived: Simply the Best.

The VGA EM-16 is built around the same Tseng Labs VLSI chip, as are the majority of the other cards that we look at in this review. It comes with five crystals, a pair of BIOS chips, and carries both a 9-pin digital and a 15-pin analog port on the card bracket. The bracket also has two jumpers and a hole that gives you access to the four-switch DIP block. It has a feature connector and is capable of displaying 1,024 by 768 resolution. The DRAM memory chips are all socketed, making it easier for the user to replace chips than if they were soldered into position. (A 256K version of the card is available for $449, and STB also sells an 8-bit 256K card called the Auto VGA.)

The card comes with three disks of software. In addition to drivers for many popular programs, including *Microsoft Windows/386*, they contain a few utilities. One of these utilities allows you to select the display mode and another relocates BIOS into memory (either through a CONFIG.SYS driver or a separate program). There are also the Hotkey and Hotzoom utilities, which enable you to zoom in and pan around a graphics screen in another application. The disk includes an impressive demo that shows off the VGA EM-16's capabilities.

The card's performance on the PC Labs benchmark tests was mixed: while it was one of the slowest in our video benchmark tests, it was one of the fastest in our *Windows* performance tests. The card had a few problems with the compatibility tests, both on the BIOS and the register compatibility suites. None of the compatibility problems, such as troubles with a monochrome mode and with the Pan and Scroll test, were particularly serious.

In the final analysis, STB Systems' VGA EM-16 is an average product: what it lacks in terms of performance it makes up for in features.

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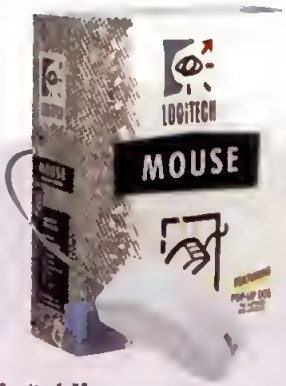

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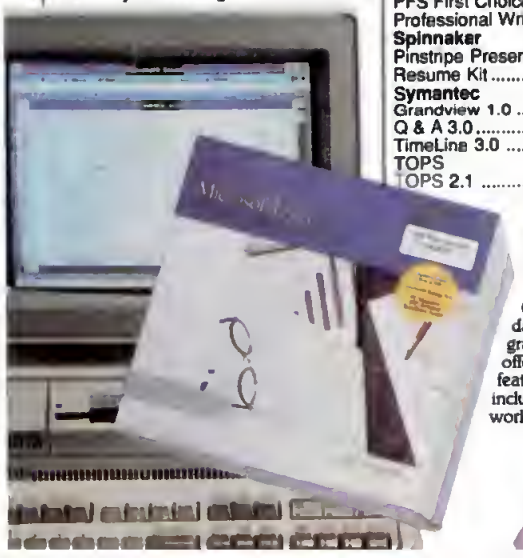

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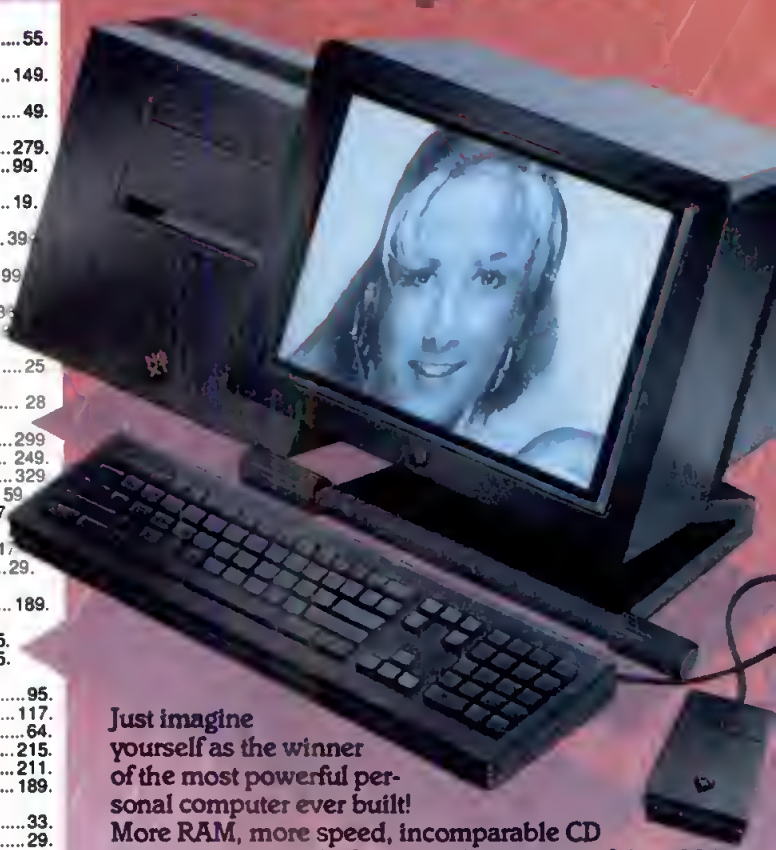

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TATUNG COMPANY OF AMERICA INC.

Tatung VGA

by Catherine D. Miller

At $439 for a 256K card, the Tatung VGA is one of the lowest-priced VGA cards we reviewed. This half-length card is also one of the fastest.

The Video Seven VGA chip set is the engine driving the Tatung VGA's operations. This well-designed board has 256K of 120-nanosecond surface-mounted DRAM. In fact, many of the board's chips use surface-mount technology, thus decreasing the number of chips on the board.

An auto-sensing feature determines if the board is installed in an 8-bit or a 16-bit slot; the Tatung supports both 8- and 16-bit video BIOS and video RAM. DIP switches, accessible only if you remove your computer's cover, configure the board for backwards compatibility emulation, impose standard VGA mode, and force 8-bit ROM and BIOS access. The board has one 15-pin analog connector.

The Tatung VGA is capable of displaying 16 colors at both 640 by 480 and 800 by 600 resolutions, as well as 256 colors at 600 by 400, from a palette of 262,144. It supports three extended text modes—80 by 43, 80 by 60, and 100 by 60—directly through DOS with the Enhancement Selection Utility. Another way to access all of the extended VGA text modes is to replace ANSI.SYS with Tatung's VGA-ANSI.SYS driver. The card comes with a RAMBIOS.SYS driver to load the video BIOS into system RAM.

An auto-sensing feature in the half-length card determines if the Tatung VGA is installed in an 8- or 16-bit slot.

Tatung claims the board is both BIOS and register compatible, and the card failed but one compatibility test: our register-level compatibility Pan and Scroll test, one of the most troublesome tests for these cards.

Software drivers are included for only *Lotus 1-2-3*, *Symphony*, *Microsoft Windows/286*, *AutoCAD*, and *AutoShade*. For $10, you can buy a disk that has both *Microsoft Windows/386* and *GEM* drivers.

TECMAR

Tecmar VGA/AD

by Alfred Poor

The Tecmar VGA/AD is a midpriced card offering better-than-average performance. It has a list price of $695 and comes with a wealth of interesting features, including some unusual ones.

The most attractive feature of the

EDITOR'S CHOICE

- VGA Wonder

It's all in the chip, the people at ATI say rather smugly. They don't elaborate, but there's no doubt that *something* in their proprietary chip is responsible for making the VGA Wonder board so fast. ATI's cards are capable of processing video bits faster than any of the competitors, even the highly-touted Video Seven V-RAM board—and they cost about 40 percent less than it does, with retail prices of $699 for 512K and $499 for 256K. On the street, the 256K version is selling for as little as $280.

But ATI Technologies' VGA Wonder offers more than just speed. Among its wealth of features is a bus mouse port, which at present comes with a Microsoft-compatible mouse. Although the VGA Wonder can generate resolutions as high as 1,024 by 768 pixels, it is not compatible with IBM's 8514/A, which generates the same resolution but uses a different coprocessor.

Like the high-performance VGA cards we've compared it with, the VGA Wonder has a 16-bit data path and is able to display the 800 by 600 resolution needed for Super VGA. Of all the VGA card configurations available, we think that this 16-bit, 800 by 600 combination offers the most bang for the buck. These cards let you display the 50 percent more pixels that Super VGA offers—and move them around a lot faster than an 8-bit card can—for about an extra $125 or so.

At present, however, Super VGA is a standard-in-waiting. Until it reaches the point of acceptance where software manufacturers write drivers to support it, you're dependent upon the VGA card you buy to supply Super VGA software drivers. While ATI's VGA Wonder offers a fairly decent selection, like more than half of the cards reviewed it lacks a *Windows/386* driver.

One card that does comes with an 800 by 600 *Windows/386* driver (though you have to pay an extra $10 for that plus a *GEM* driver) is the Tatung VGA—our honorable mention—from Tatung Company of America. Tatung's half-length card is the smallest we reviewed; it is also among the cheapest and fastest. Priced at $439, it comes with only the bare necessities: a 15-pin connector for analog signals and 256K, which is enough memory to display 16 colors at 800 by 600, the highest resolution it can handle. But it gives you everything you need, including six other Super VGA drivers.

Seven extended-resolution drivers may not sound like many; the most that any of these cards comes with is 11. This lack of drivers may seem appalling, but it's actually the latest phase in the evolution of these cards. Looking back shows how far they've come: when we examined VGA cards a year ago, we were unable to pick an editor's choice because of rampant VGA compatibility problems. While the cards tested for this review had some minor compatibility difficulties, all of them except Communication Inter-Globe's Toucan VGA 1024 should perform acceptably with software drivers written for IBM's VGA standard. Onward and upward!

VGA/AD is its software: it's got plenty. It has the usual utilities, such as a BIOS relocator, an ANSI.SYS emulator, and a mode-setting program. It also has comprehensive diagnostics, a screen saver, and a TSR that gives you access to different modes through hotkey combinations.

The card—which is able to display 1,024 by 768 and 800 by 600 resolution—also comes with the largest number of Super VGA drivers, some of which are not found with other cards. In addition to the typical *Microsoft Windows/286*, *GEM*, *Ventura Publisher*, *Lotus 1-2-3*, and *AutoCAD* drivers, it offers support for *Symphony*, *WordStar*, *Generic CADD*, *FastCAD*, *VersaCAD*, and *WordPerfect*. It lacks a *Microsoft Windows/386* driver, however.

The two-thirds-length card comes with a Tseng Labs VLSI controller chip, seven crystals, and 512K of 100-nanosecond DRAM chips soldered into place. There are both 9-pin and 15-pin connectors, as well as a VGA feature connector. The board also has pins for a daughterboard, although there are no hardware expansion options available yet. The six-switch DIP block can be reached through a hole in the card bracket, and there are four jumper blocks that are used to make configuration selections. Tecmar also offers an 8-bit card, the Tecmar VGA, that can display Super VGA.

The VGA/AD turned in benchmark and performance test times that were consistently better than average. But it performed only fairly well on the BIOS and register compatibility tests, showing more problems than did most of the competition.

Overall, the Tecmar VGA/AD is a good performer with some outstanding features.

VIDEO SEVEN INC.

V-RAM VGA

by Alfred Poor

With a list price of $1,099 for the 512K model we tested, the V-RAM VGA from Video Seven earns the distinction of top price among the cards in this review. What causes the price differential, and what more do you get from this card compared with the competition?

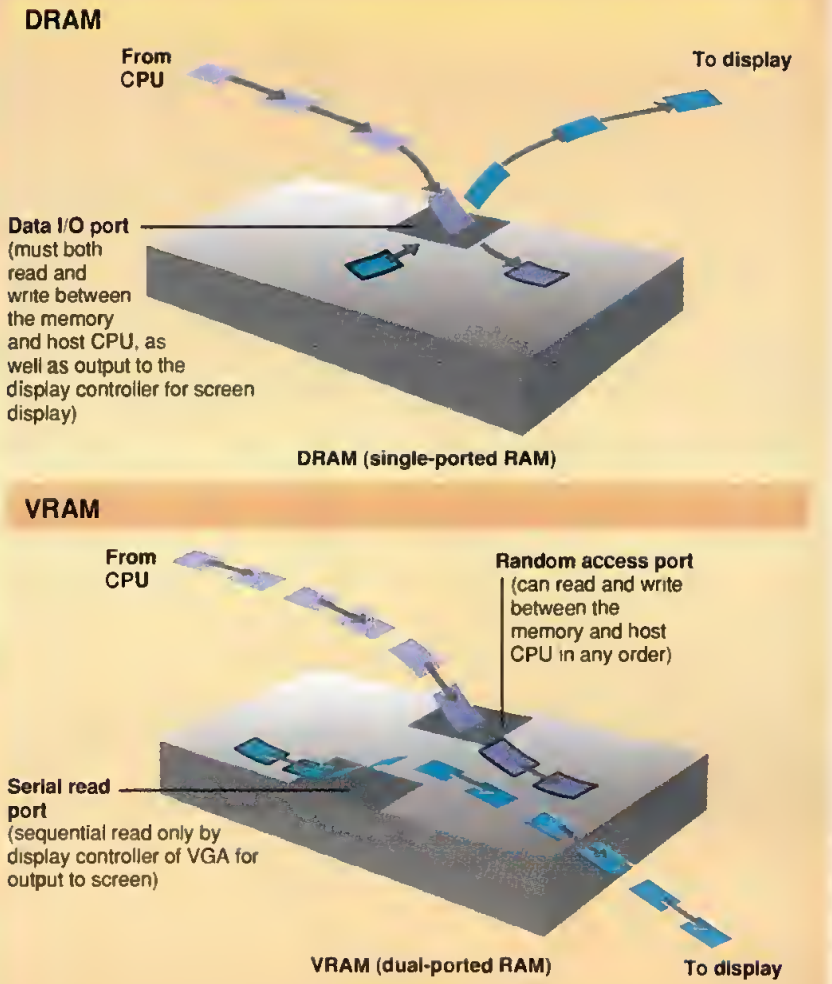
You're bound to notice the one major difference that answers both these questions as soon as you take the card out of its box. There are no familiar DIP RAM chips. In their place, along the left edge of the full-length card, you find two banks of skinny ZIPs (zigzag in-line packages) that add up to 512K of video RAM. This video RAM is what gives the card its V-RAM name, and the ZIPs also affect its performance.

The V-RAM turned in some of the fastest times on the PC Labs benchmark tests, indicating that the special memory does appear to pay some dividends. It did not blow the doors off all comers, however, finishing second on both the video benchmark and *Windows* performance tests.

The V-RAM card also scored well in the compatibility tests, with only a minor glitch in the BIOS tests and the same jumpiness on the Pan and Scroll test as found with most of the cards tested.

The card itself has a low profile. It is less than 3 inches high and it comes with the expected Video Seven controller chip. The end bracket holds a 15-pin analog port, but there is no 9-pin digital port. More significant is the inability to access the eight-switch DIP block through the

THE SECRET OF VRAM: DUAL PORTS



The difference between dynamic and video RAM memory chips is in the number of data ports they offer. Since DRAM chips must be read from or written to via the same port, data passing from the CPU to the memory chip to the monitor must take turns. Thanks to their dual ports, VRAM chips can simultaneously output video data to the display monitor while receiving information from the CPU.

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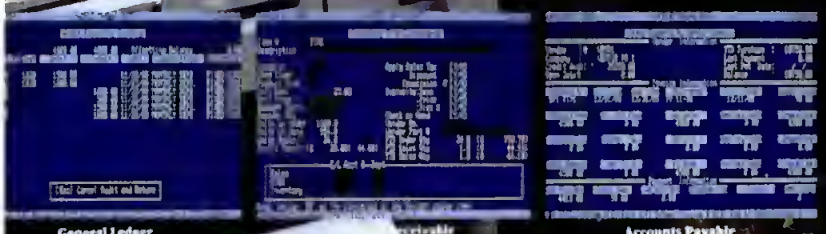

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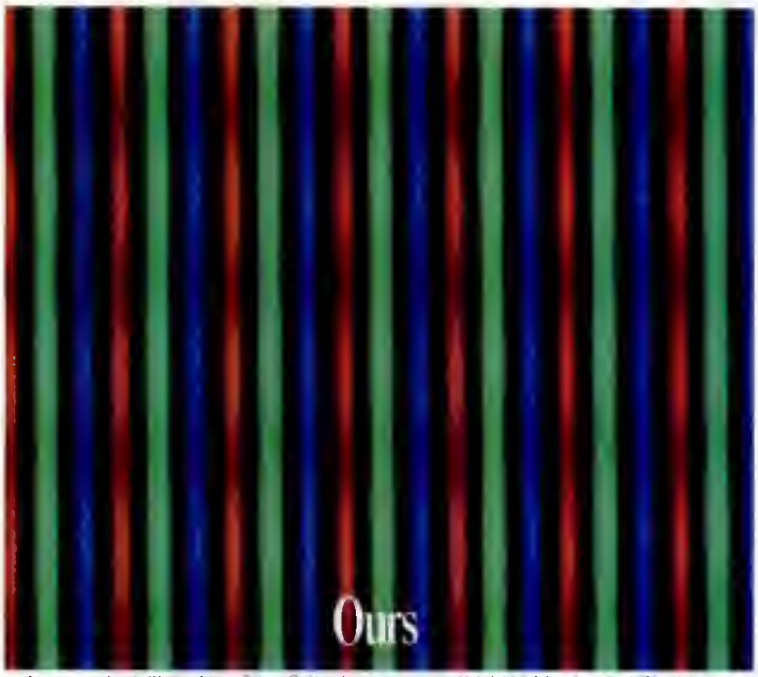
bracket; to change the configuration switches or adjust any of the five jumper blocks, you must open the computer case and probably remove the card completely.

The V-RAM does offer some interesting configuration options. Unlike many of the boards tested, it allows you to select compatibility with either the PS/2 motherboard or the expansion board version of IBM's VGA standard. The card has the VGA feature adapter and rows of pins to accept a daughtercard, even though there are no options currently available that use them.

The Video Seven V-RAM VGA turned in some of the fastest times on the PC Labs benchmark tests, but it did not blow the doors off all comers.

While our tests do indicate that the V-RAM VGA offers good performance, other cards can deliver similar results. And by charging a 50-percent premium for the V-RAM, Video Seven loses its competitive edge. Video Seven does offer two other VGA cards without V-RAM: the 8-bit VEGA VGA and the 16-bit FastWrite VGA. The latter may merit a serious look. We tested the entire line to compare the speeds of 8-bit, 16-bit, and 16-bit V-RAM cards, and in those tests we were impressed by the FastWrite's speed in both the *Windows* performance and the video benchmark tests. ■

Catherine D. Miller is a staff writer at PC Magazine. *Alfred Poor is a microcomputer consultant based in Perkasie, Pennsylvania. He is a frequent contributor to* PC Magazine. *Ken Shelby is a programmer and electronics aficionado especially interested in video adapters.*



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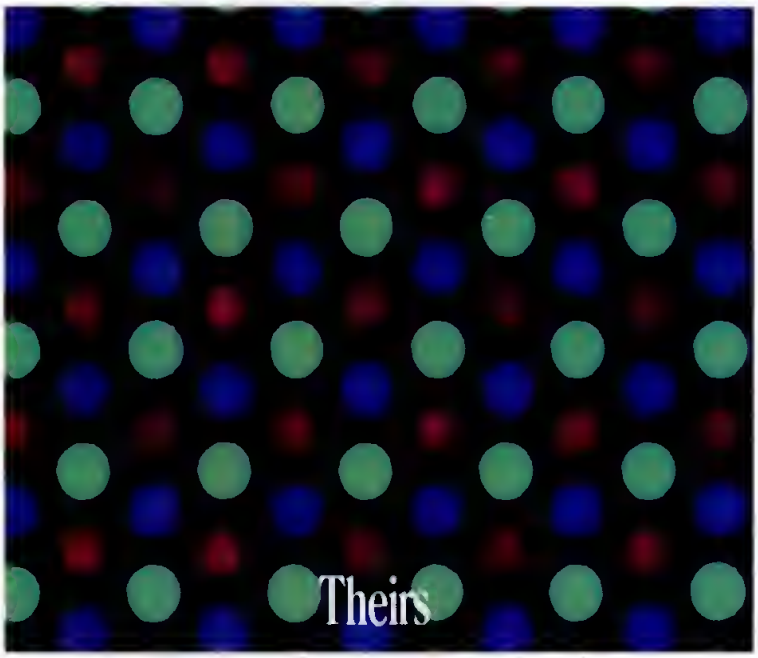

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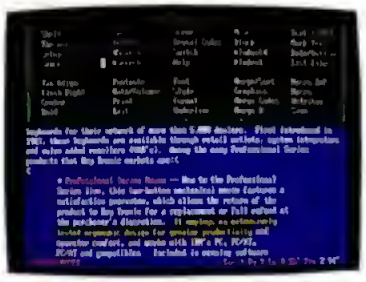

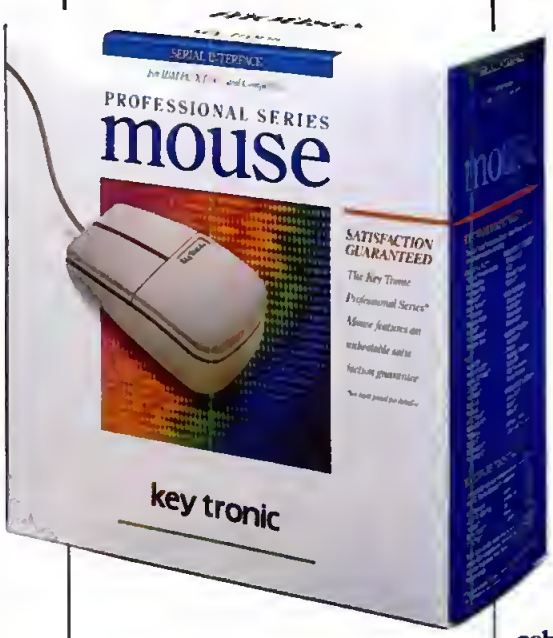

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CIRCLE 214 ON READER SERVICE CARD

SuperCalc 5

Major Overhaul for a Longtime Contender

by Craig Stinson

The latest release of this venerable spreadsheet program offers many of the sophisticated features of *Microsoft Excel* in a text-based interface that runs even on 8086-based computers.

For all of its nearly 10-year history, *SuperCalc* has found itself in the role of Avis, fighting to catch the leader by trying harder.

In the beginning, the part of Hertz was played by *VisiCalc*. *SuperCalc*, staking out the CP/M marketplace, nipped at *VisiCalc*'s heels by not being copy protected, by bundling itself with the hot-selling Osborne computer, and especially by offering innovative feature improvements, such as individually variable column widths.

Lotus 1-2-3 arrived and slew *VisiCalc*, but *SuperCalc* held onto its CP/M constituency. When it was ready to enter the MS-DOS world, *SuperCalc* was able to make inroads against *1-2-3* by not being copy protected and by offering significant feature improvements, such as better graphics, better bulletproofing to help prevent users from making unpleasant mistakes, and more-sophisticated modeling and simulation capabilities. Through the mid

to late 1980s, while *1-2-3* stagnated (and remained copy protected), *SuperCalc* hung in there by getting sold to a major mainframe software publisher (Computer Associates) and by incorporating evolutionary improvements.

About a year and a half ago, something happened to interrupt this pattern. Microsoft introduced *Microsoft Excel*, a revolutionary advance over *SuperCalc*, *1-2-3*, and everything else in the field. *Excel* brought worksheet linking, superb charting, presentation-quality output, and—through *Microsoft Windows*—the promise of compatibility with the most innovative applications of the future.

CHASING TWO TAILS

Now Computer Associates International has two leaders to chase—market Goliath *1-2-3* and the perceived champion of the avant-garde, *Excel*. The company has come forth with a gamy competitor to both, and one that creates a niche squarely between the two leaders. That niche consists of *1-2-3* users who want *Excel*-like features but won't switch to *Excel* because of the hardware expense involved.

Computer Associates is doing its best to convert these budget-conscious "heat seekers" by offering worksheet linking and a degree of "publishing" capability, by bending over backward to handle *1-2-3* commands, by incorporating memory-management techniques to keep the product viable on first-generation PCs, and by offering the ultimate feature list for a character-based spreadsheet program.

The *1-2-3* accommodations include the ability to read and write .WK1 and .WKS files directly and the provision of a *1-2-3* menu tree as an alternative to *SuperCalc*'s native command set. There's also a financial inducement: until June 30, 1989, users of any spreadsheet program can get a copy of *SuperCalc*, Version 5.0 (more often called *SuperCalc5*), by submitting $100 and the scalp (title page) of their current program's manual.

In its foreign relations with Lotus, *SuperCalc5* borrows from the Philippe Kahn bag of tricks. *SuperCalc* users, like *Quattro* users, can now read and write *1-2-3* files simply by specifying a filename extension of .WK1 or .WKS; no separate translation step is required.

BORROWED BORLAND TRICKS

The alternative Lotus menu is also a Borland innovation, but Computer Associates has refined the idea. Where *Quattro* users have to go through a bit of rigmarole to install the alternative menu tree, émigrés to *SuperCalc5* can issue Lotus-style commands ad hoc whenever they have trouble remembering the *SuperCalc* equivalent. After each use of the *1-2-3* menu tree, the system reverts to its native tree. Those who want to get rid of the *SuperCalc* menu can install a *1-2-3* tree permanently, but they'll still need *SuperCalc* commands for features that don't exist in *1-2-3*.

Because *SuperCalc5* knows how to interpret Lotus commands, importing *1-2-3* macros is almost completely painless. The program just adds syntax to ensure that the imported macros are run against its Lotus command interpreter instead of its native menus. The whole Lotus macro language, including Release 1A's /X commands, is supported.

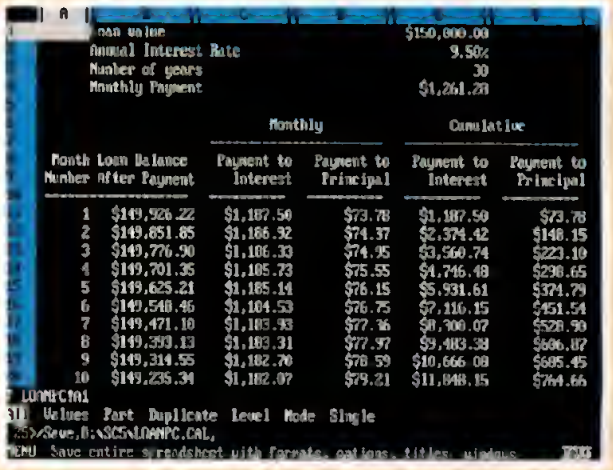
Pleasing *1-2-3* users was apparently such a major objective in this release of *SuperCalc* that the program's designers even adjusted one function-key assignment (the manual recalc button is now F9 instead of F7) to conform to the "industry standard." A few long-term *SuperCalc* users may be irritated by this capitulation, particularly since the manuals don't consistently reflect the change.

A second major objective in this release was to remain operable on entry-level hardware. *SuperCalc5* accomplishes this—to a degree, at any rate—in two ways: by remaining character based and by making its advanced features modular and removable.

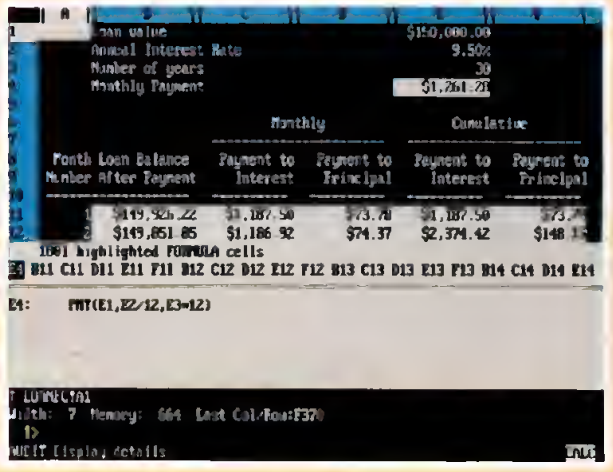
GREAT GRAPHICS

SuperCalc5 offers stunningly attractive graphics, including charts in 3-D perspective that are not to be found in *Excel*. But

SuperCalc5's menu system, shown at the bottom of the screen, is intricate. For example, after you've entered /Save and supplied a filename, you still have seven more options to choose from.



SuperCalc5's auditing module has found 1,801 cells containing formulas; the Details command can be used to display the contents of each highlighted cell.



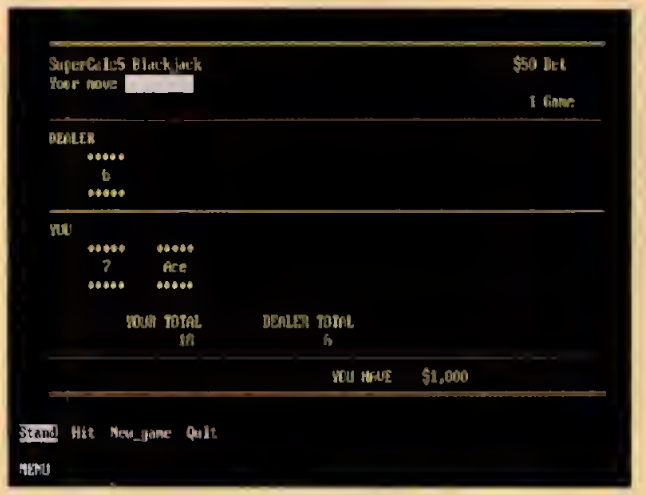
you can still run the program without a graphics board; you just don't see your charts until you print them. The new version also attempts to keep up with the high quality of output that's been *Excel*'s hallmark and that's now available, via *Allways* and *Impress*, in *1-2-3*, Release 2, as well. If you have an HP LaserJet or a PostScript printer, you can assign fonts, point sizes, rules, and shading from an Output Attributes menu. But you don't need a fast processor and a graphics screen to take advantage of these features—*SuperCalc* keeps all printing enhancements out of sight until print time.

As for memory requirements, *SuperCalc5* supports up to 32MB of expanded memory (LIM 3.2 or 4.0), but you can create modest-size worksheets in as little as 512K. A setup option lets you run the program with or without overlays; in the latter mode, you can get faster performance but you will have less free RAM.

In either mode, *SuperCalc5* adjusts itself in other ways to your memory size. If things are getting tight, it kicks out its new minimal recalc feature or its new undo capability—or both. If you start by invoking too large a data file at the DOS command line (or if you happen to have too many TSRs or device drivers installed), *SuperCalc5* goes so far as to abandon its graphing module. You then get an error message and an explanatory "answer screen" the first time you try to use the //Graphics command.

640K IS REALLY A NECESSITY

These memory-management techniques enable Computer Associates to run banner heads across double-truck ads proclaiming that you can save $6,000 by moving to



SuperCalc5's macros can be used to create custom menus. With the traditional spreadsheet borders removed, as in this example, users may not even realize they're working with a spreadsheet application.

SuperCalc5's three-dimensional perspective lets you create unstacked area charts on multiple data series.

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CIRCLE 492 ON READER SERVICE CARD

SuperCalc5 instead of *Excel*. But the ads obscure a basic truth: *SuperCalc5* is so powerful and so feature-rich that running it properly demands at least a 640K PC. Doing any large-scale work demands expanded memory. Users who move to *SuperCalc5* with 512K systems are likely to have rude shocks awaiting them.

A better method of accommodating small-memory systems would have been for *SuperCalc* to offer disk-based virtual memory (as *Framework III*, *Lucid 3-D*, and others do). A technical spokesperson at Computer Associates said this option was under consideration for the future.

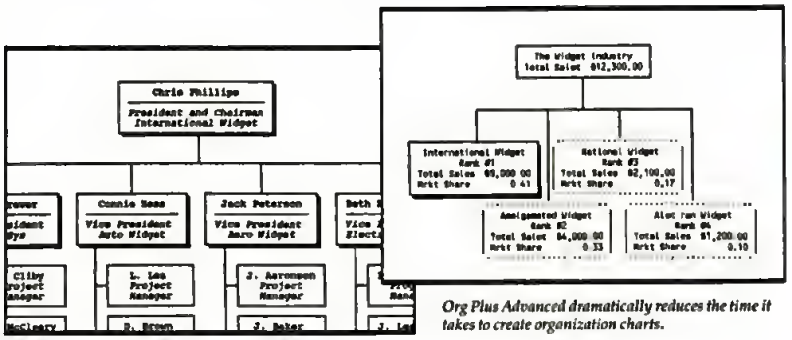
As for the company's assertion that *SuperCalc5* runs satisfactorily on 8088-based machines (XTs), this review can neither confirm nor refute it. (*PC Magazine*'s standard testing configuration is an 8-MHz IBM PC AT Model 339 with 640K, 1MB of expanded memory, and no coprocessor.) But we can state that *SuperCalc5* runs slower than *SuperCalc4*. On three benchmark-test spreadsheets involving brute-force arithmetic calculations, the creation of a 360-month amortization schedule, and a test of the internal-rate-of-return function, *SuperCalc5* turned in times that were 16 percent, 55 percent, and 11 percent slower, respectively, than the same tests run on *SuperCalc4*.

Computer Associates acknowledges that *SuperCalc5* performs brute-force recalculation slower than its predecessor. The explanation, says Computer Associates, is that the program is larger and offers more features. One of those new features, minimal recalculation, should more than compensate for the reduction in brute-force speed. With minimal recalc in effect, *SuperCalc5* recalculates only those cells whose values might change as a result of a new or altered entry. With many typical worksheets, minimal recalc means that you never have to turn off automatic recalculation. So—provided you're not trying to run a large worksheet on a 512K system (in which case *SuperCalc* will jettison its minimal recalc)—the slower speed of *SuperCalc5* should not be a serious impediment to usability.

With the minimal recalc feature in effect, SuperCalc5 recalculates only those cells whose values might change as a result of a new or altered entry.

SuperCalc5's strongest inducement to would-be switchers is an armload of new features. Here is an overview:

Worksheet linking. *SuperCalc5* offers two modes of worksheet linking. You can create multipage worksheets (up to ten pages per sheet), in which formulas on one page are linked to cells on others. Or you



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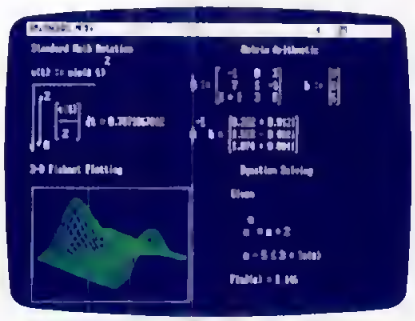
CIRCLE 496 ON READER SERVICE CARD

After centuries of practice, mankind perfects engineering calculations: MathCAD.

Announcing MathCAD 2.5: The Dawn of a New Age.

What the historians will call it, only time will tell.

Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.



MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.

MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now—whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

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But don't take our word for it; just ask the experts. PC Magazine recently described MathCAD as "everything you have ever dreamed of in a mathematical toolbox."

PC MAGAZINE EDITORS' CHOICE
March 14, 1989 issue.
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**If you purchased MathCAD 2.0 between 5/1/89 and 6/16/89, you can get a FREE upgrade to version 2.5 (otherwise, the upgrade cost is $99.00 until June 30, 1989; afterwards, the cost will be $149.00).*

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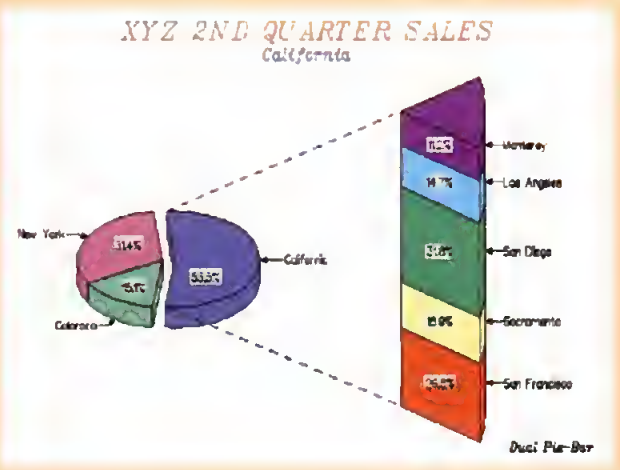
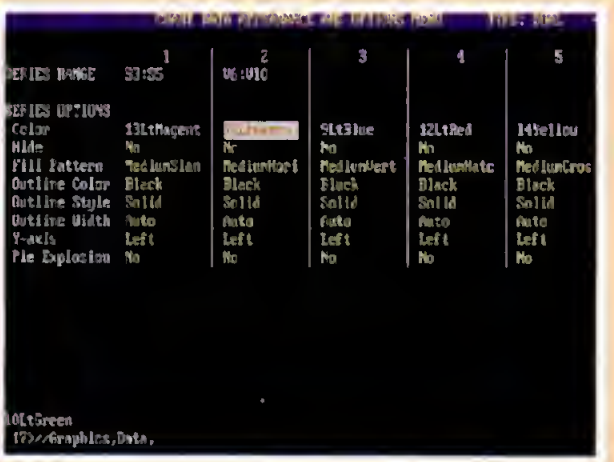
CIRCLE 154 ON READER SERVICE CARD



SuperCalc5's dual charts let you see two levels of detail at once.

SuperCalc5 is one of the few spreadsheet programs that offers high-low charts.



Graph customization in *SuperCalc5* is assisted by full-screen option-status displays.

can simply connect cells on one worksheet to cells on entirely separate sheets.

The multipage approach is particularly suitable for the consolidation of tables that are laid out identically. The spreadsheet simply takes on a third dimension, allowing you to "bore through" from the front of the model to supporting data lying behind. (Rumor has it that *1-2-3*, Release 3, will also offer multipage modeling.)

The multiworksheet approach, now best exemplified by *Excel*, is great for such things as reusing supporting data in many separate contexts. It also helps users avoid memory overload. You don't have to have the supporting worksheets in memory to reference them. You can make live connections with data stored on your hard disk or on a network server (IBM PC Network, IBM Token-Ring Network, 3Com, Novell, Banyan, or StarLAN).

Multiple worksheets in memory. Whether or not you link, you can keep up to 255 worksheets in memory at once. *SuperCalc5* can display up to three at a time, dividing the screen into equal horizontal segments. The program offers easy commands for navigating among any of the 255. A simple function-key press displays a list of all sheets currently in RAM.

New graph types and features. *SuperCalc5* offers several new graph types, including radar (which uses polar coordinates), word, and dual. There is also three-dimensional-perspective display.

The word charts, in single, dual, and triple columns, are handy for creating slide presentations. Many users will want to take advantage of Computer Associates' overnight 35mm slide service (offered through MAGIcorp) to finish the job.

As for 3-D, the new features don't let you plot data on three axes, but they do make it easier to present multiple data series in the traditional *x,y*-coordinate space. For example, you can now plot multiple series in an area chart without having to stack the series; *SuperCalc5* simply plots each new series "behind" the preceding one.

The dual charts let you provide two levels of detail on the same screen or printout. For example, you can show a pie graph on the left side of the screen and "zoom" one slice into a second pie on the right.

These new types significantly enhance an already extensive graphing set, which includes high-low-open-close plots as well as the usual bar, line, and overlay varieties. Altogether, *SuperCalc5*'s graphing prowess seems more extensive than *Ex-*

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CIRCLE 124 ON READER SERVICE CARD

cel's in terms of type options, and fully equal to *Excel* in terms of customizability. The placement of text in graphs, however, has to be done on the keyboard rather than with a mouse.

Integrated auditing features. *SuperCalc5*'s new auditing commands are impressive and more extensive than *Excel*'s. You can search for and highlight just about any category of cell you can think of, including dependents and consequents of a particular formula, formulas that reference empty or text cells, clones of a particular formula, cells with particular data types, cells that are not referenced by other cells, and so on. The program not only highlights the selected cells, but also presents a window displaying the exact contents and formatting attributes of each member of the set.

Also included in the auditing section of *SuperCalc5* are a panoramic view option, which lets you see a worksheet's functional layout at a glance, and an extensive search-and-replace facility. Both are handy for ordinary worksheet building as well as for troubleshooting.

Data encryption. The new version comes with a TSR encryption utility called Privacy Plus.

These new features enhance a product that was already way ahead of *1-2-3* in terms of the options it presented users. *SuperCalc5*, like its predecessors, abounds in choices and conveniences. For example:

You can set a data path from within *SuperCalc*, so you don't have to keep changing the default directory in order to take advantage of a tree-structured hard disk.

If you don't have an enhanced keyboard and you want to enter numbers with the numeric keypad, you can learn to use *SuperCalc*'s left-handed cursor diamond—Ctrl-S, Ctrl-E, Ctrl-D, and Ctrl-X. This is a handy holdover from CP/M days, when some keyboards (Apple IIs with SoftCards) had no cursor keys.

SuperCalc normally records copied formulas in a compressed format to conserve memory. If you've entered the same formula many times manually, you can use a Squeeze command to ferret out the duplicates and reclaim memory.

The macro facility includes macro recording as well as an extensive range of debugging features. Macros also can employ computed cell references. For example, the expression BUDGET!TOTAL[2;3] refers to the cell in row 3, column 2 of range TOTAL in the spreadsheet named BUDGET.

SUPERCALC5: SUMMARY OF FEATURES

	SuperCalc5	Lotus 1-2-3, Release 2.01	Microsoft Excel
GENERAL FEATURES	$495	$495	$495
LAN version available	●	○	●
OS/2 version available	●	○	○
Uses EMS memory	●	●	●
Uses extended memory	○	○	●
RAM required	512K	256K	640K
Disk storage required	3MB	2MB	5MB
MAXIMUM WORK AREA			
Number of rows	9,999	8,192	16,384
Number of columns	255	256	256
Number of rows displayed	20	20	Variable
Number of characters displayed per row	74	72	Variable
Maximum column width (characters)	127	240	255
FILE FORMATS SUPPORTED (Import/Export)			
.CSV	●/●	○/○	●/●
.DBF (dBASE)	●/●	○/○	●/●
.DIF	●/●	○/○	●/●
.WKS	●/●	●/○	●/●
.WK1	●/●	●/●	●/●
.WR1 (Symphony)	○/○	○/○	●/●
OPERATIONAL FEATURES			
Undelete function	●	○	●
Hiding ability			
Rows	○	○	●
Columns	●	●	●
Cells	●	●	●
User-selectable screen colors	●	○	●
High-bit ASCII characters (128–255) displayed	●	●	○
Extract function (saves partial spreadsheet)	●	●	●
Automatic backup	●	○	●
User-customizable backup interval	●	○	○
Formulas displayed in worksheets	●	●	●
Programmable hotkeys for shortcuts	○	○	○
Locking capability			
Rows	●	●	○
Columns	●	●	○
Cells	●	●	●
Macros	○	●	●
Formulas	○	●	●
Split screens			
Maximum number	6	2	4
Formats screens independently	●	○	○
Scrolls screens independently	●	○	●
3-D spreadsheet linking (number of levels)	● (10)	○	● (Unlimited)
Recalculation			
Background	○	○	●
Intelligent	○	●	●

●—Yes ○—No

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Supports partial payments and finance charges.
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Up to 5 user-defined aging periods
Mailing labels and reports with 7 different sorts.

Inventory

Supports LIFO, FIFO, weighted averages and standard cost.
Supports markup, margin or list.
Allows up to 4 places to right of decimal for unit cost and price

Sales Invoicing

Supports service or product onented businesses
User-defined tax tables including multiple sales taxes.
Prints packing slips.
Prints invoices.
Alerts user to customer exceeding credit limit.
Sales history reports.
Automatic updating of inventory daily.
Allows return credit memos.

Accounts Payable

Can post up to 200 general ledger expense accounts per invoice
Prints checks
Automatically prepares payments.
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Computes discounts and records discounts taken.

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CIRCLE 194 ON READER SERVICE CARD

SUPERCALC5: SUMMARY OF FEATURES

	SuperCalc5	Lotus 1-2-3, Release 2.01	Microsoft Excel
FUNCTIONS/OPERATORS	$495	$495	$495
Total number of functions			
Math (including trigonometry)	35	17	22
Logic	25	7	6
Date and time	20	11	12
Statistics	16	14	25
Number of logical and arithmetic operators	5	15	13
MACROS			
Learn mode for macros	●	○	●
Macro libraries	○	○	●
Macros reside in worksheet or in library	Both	Worksheet	Library
Macro menu	●	○	●
Imports working Lotus macros	●	●	○
DATABASE FEATURES			
Database can be larger than spreadsheet	○	○	○
Database resides on-disk	○	●	○
Number of simultaneous sort keys	3	2	3
Data record search by:			
Arithmetic criteria	●	●	●
Logical criteria	●	●	●
Database entry screen	○	○	●
Multidimensional database	○	○	○
GRAPHING FEATURES			
Graph types available	Bar, dual, high-low, line, pie, radar, tree, word, *x,y*	Bar, line, pie, stacked-bar, *x,y*	Area, bar, column, line, pie, scatter
PRINTING FEATURES			
Landscape printing	●	○	●
Landscape printing with separate utility	● (*Sideways*)	● (*Sideways*)	○
Box and shade output	●	○	●
Multifont output	●	○	●
PostScript printing	○	○	●
Supports HP LaserJets	●	●	●
Maximum length of setup string	240	240	N/A
HELP/DOCUMENTATION			
Context-sensitive on-line help	●	●	●
Separate help section	○	○	●
Quick-start booklet	●	●	●
Reference card	●	●	●
Tutorial program or booklet	●	●	●
Index to documentation	●	●	●
Command table	●	●	○
SUPPORTED THIRD-PARTY SOFTWARE			
SideKick	○	●	●
Sideways	●	●	○
SQZ	○	●	○

●—Yes ○—No
N/A—Not applicable: *Excel* uses the *Windows* print features.

NEW COMMAND CAPABILITIES

SuperCalc5 adds many new abilities to its repertoire. For example:

The /Arrange command sorts data either by row or by column and either with or without formula adjustment.

The /Blank command either erases cells entirely or leaves their formatting attributes intact, as you choose.

The /Copy command can perform consolidation arithmetic with its target cell(s).

The /Edit command can not only change the contents of a cell but also apply the altered contents to a target cell.

The /Justify command can wrap text through a target range in three styles—flush left, centered, or flush right.

The /Quit command can take you straight out of *SuperCalc* into another program (but only a .COM program!).

The /Print module includes a Preview option—but, alas, only in text mode.

The //Data command set has an Extract option that lets you include or reject records on a case-by-case basis.

The /Save commands can be applied to entire files or to specific ranges, can transfer live formulas or convert everything to computed results, and can make a backup of the last version saved on-disk, if you wish. The /Load command includes a similar range of options.

HARD TO LEARN

All these variations on the standard spreadsheet operations (and there are more—this is only a sampling) bespeak *SuperCalc*'s long history of "trying harder." They also, unfortunately, constitute something of a learning hurdle for new users—particularly for converts from Lotus, who might expect their fingers to adjust to the *SuperCalc* menus with a minimum of relearning. The problem is twofold.

First, the complexity and richness of *SuperCalc* stretches the construct of a static two-line horizontal menu system beyond what it's gracefully able to handle. If ever there were a program that cried out for dynamic menus (menus that change as the program is used, among other things adjusting to show which commands are and are not currently valid) and dialog boxes, *SuperCalc* is it. Because you must select every option and suboption one at a time, instead of being able to see a range of choices and settings in a dialog box, the *SuperCalc* menus are gruesomely deep. The program's reference manual is full of tree diagrams that run page after page; to keep track of where you are in these dia-

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CIRCLE 112 ON READER SERVICE CARD

PERFORMANCE TESTS: SUPERCALC5

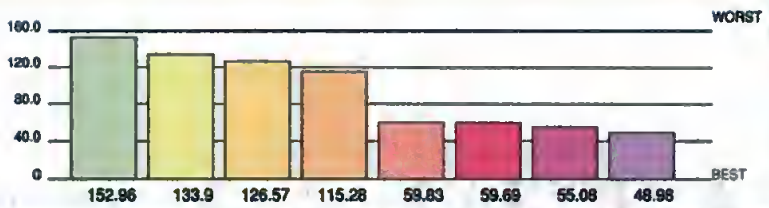
***SuperCalc5*'s performance is affected by the memory-management techniques that enable it to take up such a small amount of RAM, and by the variety and number of its features.**

To gauge spreadsheet performance, we run eight separate tests. Five tests time the interval from the initial keystroke that executes a calc function or command to the moment keyboard control has been restored. (Recalculation is set to manual.) The other three tests rely on each spreadsheet program's memory- and space-checking functions, yielding scores expressed in kilobytes. The products were tested on an IBM PC AT Model 339 with 640K of conventional memory, DOS 3.3, no expanded memory, and no math coprocessor.

Mathematical Worksheet Recalculation

Elapsed Time (seconds)

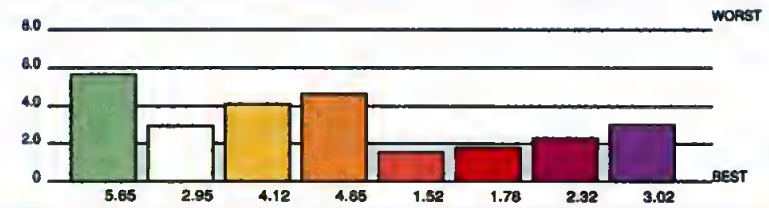
Mathematical Worksheet Recalculation reports the time taken to calculate a *Lotus 1-2-3* 2.01 worksheet with 1,950 mathematical functions and 494 text cells. Lower times indicate more-efficient implementation of standard spreadsheet functions.



Loan Recalculation

Elapsed Time (seconds)

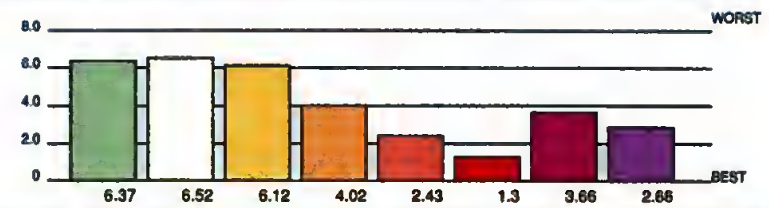
The **Loan Recalculation** test worksheet calculates the monthly payment and displays the amortization schedule for a 10-year mortgage based on any given loan principal. This test is a typical spreadsheet application.



Internal Rate of Return Recalculation

Elapsed Time (seconds)

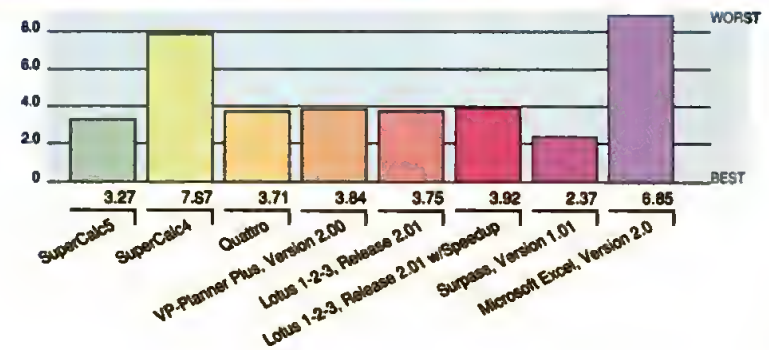
Internal Rate of Return Recalculation tests the Net Present Value and Internal Rate of Return functions. These computation-intensive formulas indicate the efficiency of a program's calculation and Internal Rate of Return algorithms.



Save to Disk

Elapsed Time (seconds)

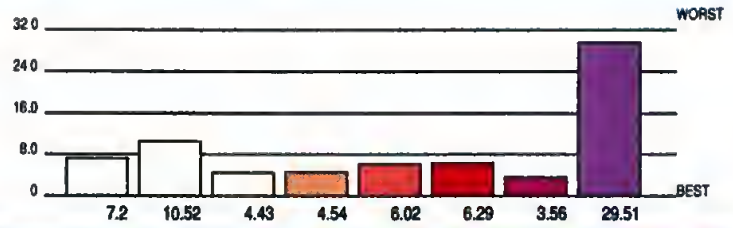
The **Save to Disk** test measures how long it takes the spreadsheet program to save the Mathematical Worksheet Recalculation test file to disk, using the product's native file format.



Load from Disk

Elapsed Time (seconds)

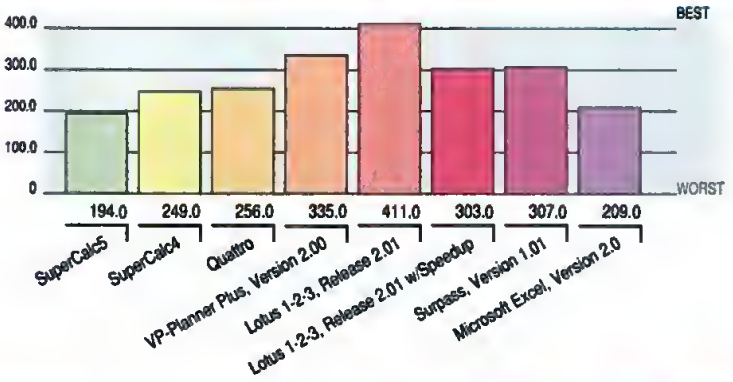
The **Load from Disk** test measures how long it takes the spreadsheet program to read the Mathematical Worksheet Recalculation test file from disk, using the product's native file format.



Conventional Memory

Available RAM (kilobytes)

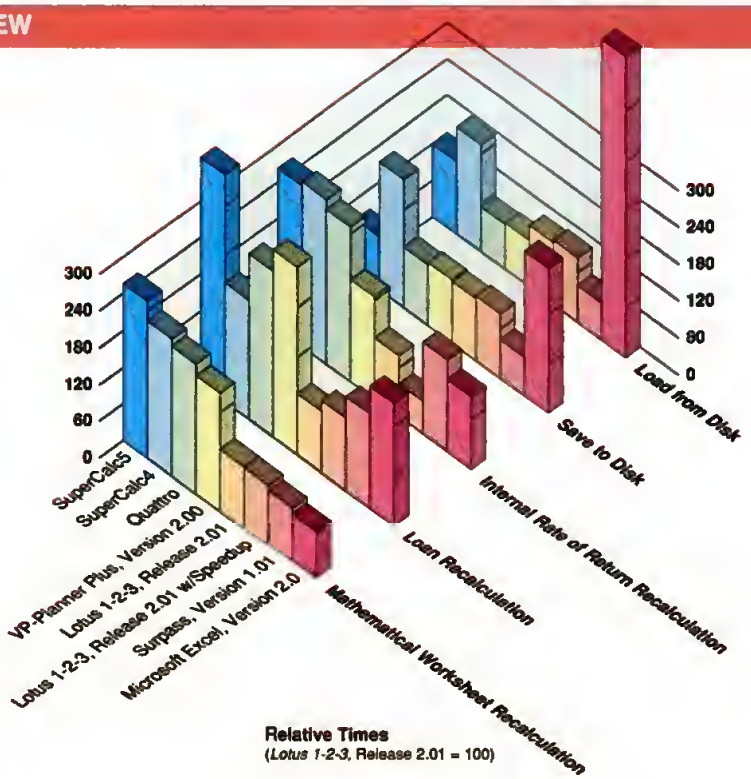
Conventional Memory reports how much RAM is available when the spreadsheet program is called but no spreadsheet file is loaded. A larger number indicates that the program can handle a larger spreadsheet.



PC MAGAZINE: SUPERCALC5: COMPOSITE VIEW

The test results show how *SuperCalc5* performed against five of the most popular spreadsheet packages on the market today as well as *SuperCalc4*. As evidenced by the numbers, *SuperCalc5* lagged behind all the other companies' packages in the Mathematical Worksheet Recalculation, Loan Recalculation, and Internal Rate of Return Recalculation. *SuperCalc5* even trailed *SuperCalc4* in two of these three tests. All results were obtained with the memory default set to FAST and minimal recalculation set to AUTO.

Although performance is not the hallmark of *SuperCalc5*, its efficient memory management earns it top honors. Although after the program was loaded it provided the smallest amount of conventional memory among all these packages, it used the least amount of memory for our BMARK spreadsheet and consumed only half of the disk space required by its closest rival, *Microsoft Excel*. *SuperCalc5* can be made more efficient by setting the memory option to DATA SPACE, disabling UNDO and GRAPHICS, and squeezing formulas.



We Interrupt T War For This Im

To all those unlucky enough to be stuck smack in the middle of the current spreadsheet confusion, take heart.

There is, at last, a viable alternative to war: revolution.

One that delivers even more performance than you have (ahem) been waiting for, but without demanding expensive new hardware or extensive retraining. And without abruptly cutting you off from any user in your company, even those on mainframes.

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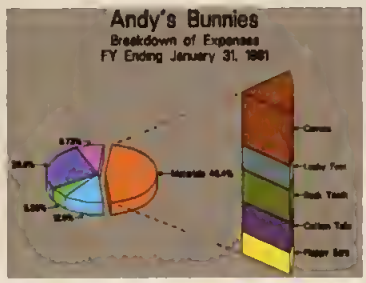

Present a state-of-the-art picture of your work.

Link just about everything in sight.

And with SuperCalc5, you select fonts, lines, boxes, grids and shading. All of which can be used to produce the highest quality customized reports.

Plus, SuperCalc5 actually makes productivity easier. An integrated Undo feature simply reverses unwanted commands. And a truly comprehensive system of debugging highlights costly errors and analyzes macro logic.

Perhaps even more impressive is the way SuperCalc5 can link spreadsheets. Up to 255

Catch bugs before they come back to bite you.

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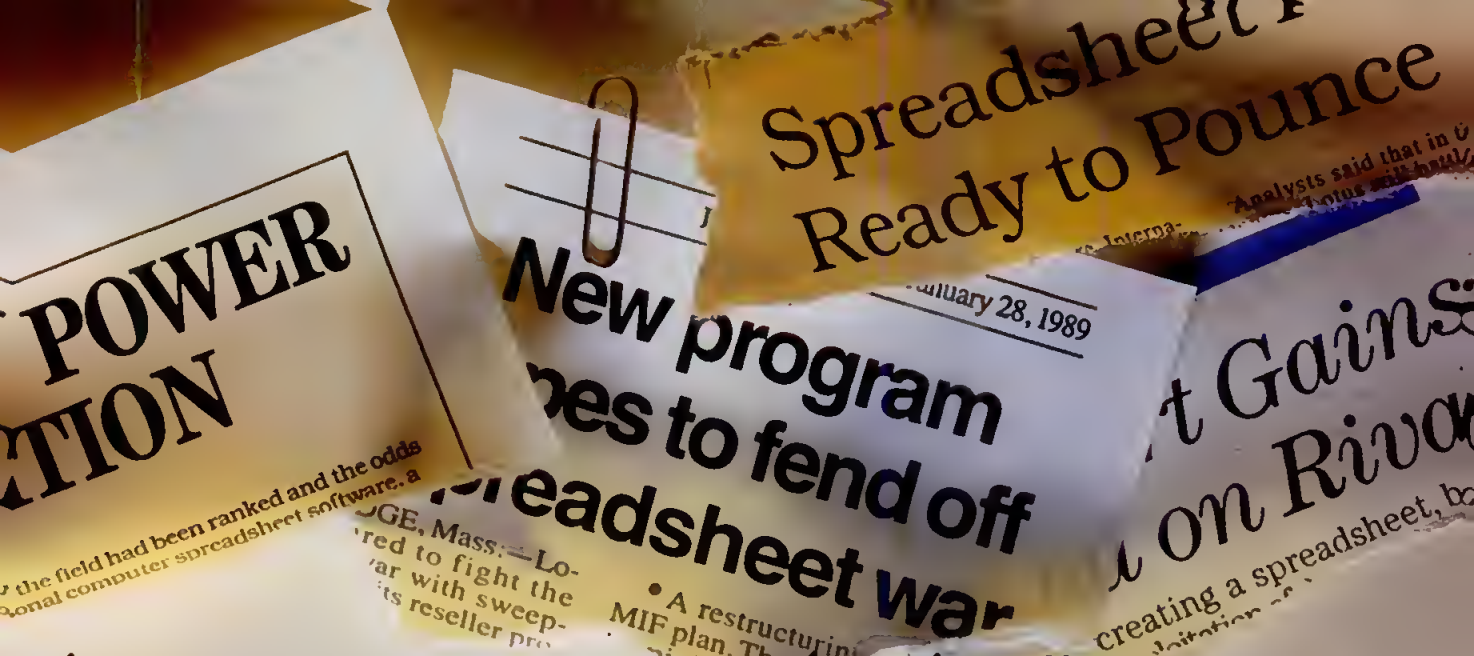
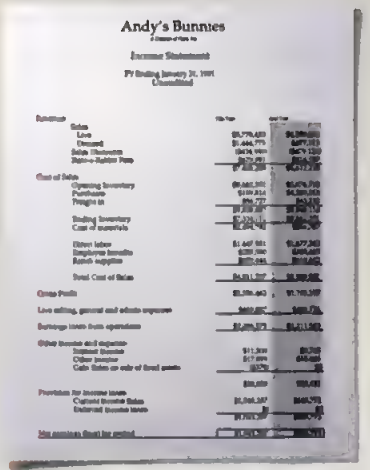


he Spreadsheet portant Update.

to be precise. Linking either in memory or on disk, either pages of the same spreadsheet or independent, either SuperCalc5's files or Lotus® 1-2-3®'s.

Which brings us to the "L" word. SuperCalc5 not only reads and writes Lotus® 1-2-3® files, it totally coexists with Lotus.



Produce annual-report quality output everyday.

Letting you easily move 1-2-3 macros into SuperCalc5 and back again. Even toggling between menus is a snap for SuperCalc5.

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Which now brings us to the "E" word. Unlike Excel, SuperCalc5 runs on all IBM® and compatible computers but also takes full advantage of 286 and 386 machines when *you* decide to make that transition.

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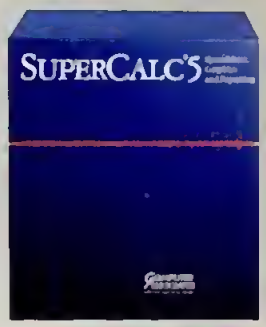

Which finally brings us to our admittedly biased outlook for the much touted spreadsheet war.

With SuperCalc5, peace is at hand.

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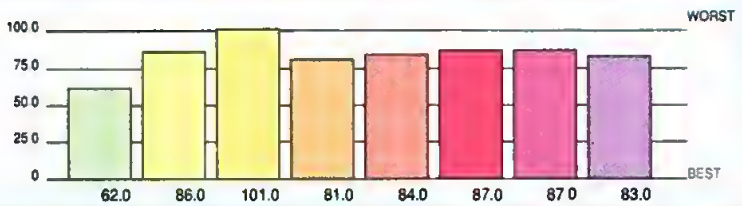
CIRCLE 102 ON READER SERVICE CARD

PERFORMANCE TESTS: SUPERCALC5

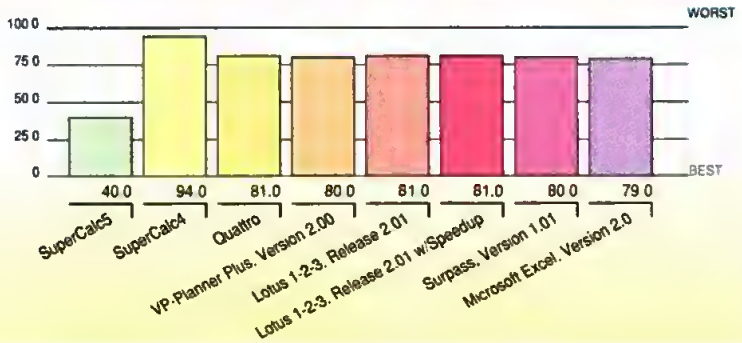
Memory Used — Required RAM (kilobytes)

Memory Used reports how much RAM in kilobytes is used by the Mathematical Worksheet Recalculation file. A smaller number on this test means the program can handle a larger spreadsheet.



Disk Space — File Size (kilobytes)

Disk Space reports the size of the Mathematical Worksheet Recalculetion file when the spreedsheet program saves it to disk in the program's native file format. A smaller number here is better, leaving room for more or bigger files on the same disk.



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grams, you practically have to rip out the pages and paste them together.

Second, the layout of commands on this menu system often appears to follow the thought lines of a programmer rather than those of a user. For example, saving a partial file (creating an extract, in Lotus terminology) is certainly an action related to saving an entire file. But as an option seldom exercised, it might better have been parked in some other branch of the tree, away from /Save. As things stand, every time you save in *SuperCalc* you have to confirm that you do indeed want to put the whole file away. Sure, it's a minor thing having to hit the Return key an extra time with every save. But it's an irritant, and one that typifies the "feel" of *SuperCalc*.

It just seems like it always takes one or two keystrokes more than you expect to get something done. The irony in this is that one of *SuperCalc*'s major strengths—the fact that it's been around a long time—is also one of its liabilities. *SuperCalc* is a solid, dependable product; the vendor is here to stay and has its support act together; but the basic user interface, built on early 1980s notions, feels ponderous by current standards. (Of course, *1-2-3*'s interface is only slightly less so—and only because there's less product to interface with; but with *Excel* in the game now, it's no longer enough to be comparable to *1-2-3*.)

A marketing spokesman for Computer Associates confirmed that the company is planning a Presentation Manager version of *SuperCalc*. That should be an interesting product to see.

THE BOTTOM LINE

This is a lot more spreadsheet than the current version of *1-2-3* (plain *1-2-3*, that is; we're not talking about *1-2-3* with *HAL* and a suite of add-ins). It's a more solid product than *Quattro*. And at least in the area of graphic output, it's as powerful as *Excel*.

But take that "save $6,000" ad campaign with a sack of salt. You won't be happy running this program on systems without at least 640K (and preferably a good deal more), and you will incur retraining expense if you're converting from another spreadsheet.

Salt notwithstanding, if you want worksheet linking, integrated auditing, and other state-of-the-art modeling features, and if you're not hot to jump on the graphics-mode bandwagon, *SuperCalc5* deserves very serious consideration. ■

Craig Stinson is a frequent contributor to PC Magazine.

FACT FILE

SuperCalc5
Computer Associates International, 1240 McKay Dr., San Jose, CA 95131; (408) 432-1727.
List Price: $495
Requires: 512K RAM, DOS 3.0 (supports LIM 4.0 and 3.2).
In Short: A major revision for the longest-running spreadsheet show in microcomputerdom, offering worksheet linking, superb graphing in 3-D perspective, and integrated auditing, among many other state-of-the-art features. Slower than *SuperCalc4*, *SuperCalc5* doesn't work well with under 640K RAM. And the wealth of new features may make it difficult for users of previous versions.

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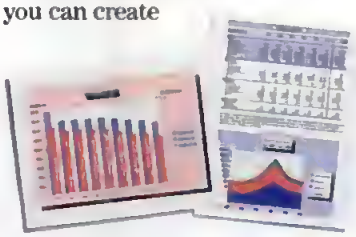

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☐ **INDIVIDUAL CREDIT.** Complete sections "a" and "b" only.

Please complete all appropriate sections, providing at least two year's residence and employment history. This will enable your application to be processed as quickly as possible. If you are self employed, please be sure to complete section "D" on back.

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Date of Residence: Month Year Monthly Payment: $ Buy ☐ Rent ☐ Other ☐

Previous Address: Dates of Residence: From To

Your Employer: (If self-employed, see rear panel) Date of Employment: Mo. Yr. Position: Monthly Income: Gross $ Net $

Employer's Address: Street City State Business Phone: ( ) –

Previous Employer: Address: Dates of Employment: From To

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I have received since: (Date) Monthly Income: Gross $ Net $

Name and Address of Nearest Relative Not Living With You Relationship

b. Credit Information

Include joint applicant's information, if joint account requested.

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Bank Account:		☐ Checking ☐ Savings	
Bank Account:		☐ Checking ☐ Savings	
Bank Loan Reference:		Payment	Balance
Bank Card Reference: ☐ VISA ☐ Mastercard			
Other Credit Card Reference			
Other Credit References:	Account No.: Expires:		

Driver's License No. State Expires:

c. Joint Applicant's Personal Information

*If you are a married Wisconsin applicant, you must provide your spouse's information below, even though your spouse may not be signing this contract.

Joint Applicant's Name: First Initial Last Date of Birth: Mo. Day Yr. Social Security Number:

Address Street Apt # City State Zip Date of Residence: Mo. Yr. Home Phone ( ) –

Employer: Date of Employment: Mo. Yr. Position: Monthly Income: Gross $ Net $

Employer's Address: Street City State Business Phone: ( ) –

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d. Self-Employed Information

Complete this section only if you are self employed.

Business Name ☐ Proprietorship ☐ Corporation ☐ Partnership

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Description of Business Your Position In Business Since

Your annual income from business. Business' annual income (gross) (net)

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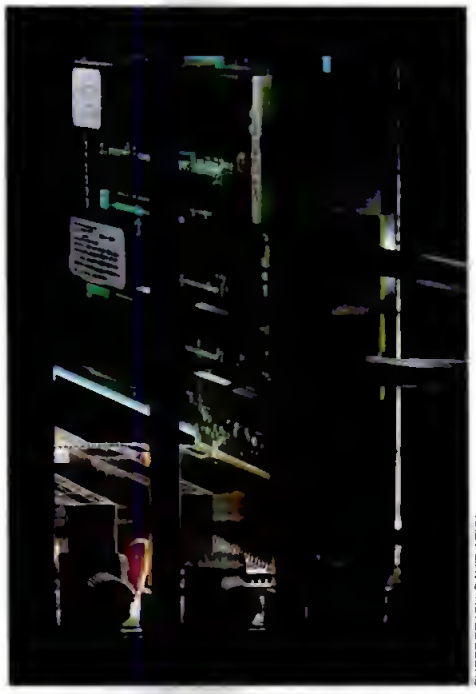
Inside Talk: 2,400-bps PS/2 Modems

by M. David Stone

These ten 2,400-bps add-in modem cards work with the Micro Channel architecture of the IBM PS/2.



PHOTOGRAPH: DAVID ARKY

The trend on the part of modem makers toward designing modems for IBM's PS/2 computers seems to mirror the buyers' inclination toward that same line. Though at least 25 manufacturers have promised internal modems for the Micro Channel architecture since the first one was introduced a year ago, there's been a lot more talk than action.

Or so it would seem, since at the time of this writing there were only ten modems available from manufacturers willing and able to have us review them. Ranging in price from $299 to $899, with most in the $300 to $450 range, the MCA modems reviewed in this issue are the Anchor Automation 2400PS, Anderson Jacobson AJ 2412-3H1, Everex Evercom 24/2, Hayes Smartmodem 2400P, Intel 2400B Modem 2, Multi-Tech MT224PS and MT224ES, Octocom OSI8224APS, OmniTel Encore 2400PS, Practical Peripherals PM2400 PS/2, and Ven-Tel MCM-24.

There are, however, at least ten other MCA modems available that we didn't review. It seems that making modems work with the MCA bus is not as easy as with the PC bus. Although some of these modems simply weren't available in time to meet our review deadlines, we didn't review others be-

cause manufacturers decided that the products with which they'd provided us weren't working properly. Finally, we didn't review some of them because they were unable to perform adequately on our tests (see sidebar "Survival of the Fittest"). After consulting with the manufacturers of these poorly performing modems (as we always do when products exhibit serious problems) the manufacturers asked us not to review them at this time because they wanted to iron out the kinks.

This list of unreviewed but currently available modems includes the PS/2-oriented products of Acer Technologies, Advanced Microcomputer Systems, Black Box Corp., Computer Peripherals, GVC Chenel, Okidata, Prometheus Products, Racal-Vadic, Universal Data Systems, and U.S. Robotics. It is quite possible that most or all of these modems could perform adequately on our tests at the present time, but none of these companies could supply adequately performing modems in time to meet our testing deadlines.

SAVE THE SERIAL

There's no doubt that there is a serious advantage to using an internal modem with a PS/2: it leaves the serial port on the system board free for some other purpose such as a serial printer or plotter.

That these modems support the 2,400 bit-per-second V.22 bis standard is also an advantage. Now the modem communication speed of choice—fully 66 percent of the people making purchases today are buying 2,400 bps—virtually all V.22 bis modems are compatible with the older, slower Bell protocols. This allows them to communicate using the Bell 103 protocol of 0 to 300 bps and the Bell 212 protocol of 1,200 bps.

Besides Bell compatibility, many V.22 bis modems have the additional option of communicating at 1,200 bps using the CCITT V.22 protocol—the European equivalent of Bell 212. This additional capability is of no importance for communication within the U.S., but it may be helpful if you need to communicate internationally. (Developed by the Bell Telephone Company before the breakup of their monopoly, the Bell protocols are strictly U.S. standards and are named after particular modem models. The V.22 bis protocol was developed by the European-based CCITT [Comité Consultatif International Télégraphique et Téléphonique], and has the advantage of being a worldwide standard.)

DOUBLE FOR LESS

As recently as 2 years ago, 1,200 bps was clearly the business standard for modems. At that time, a typical street price for the Hayes Smartmodem 2400 was $600, compared with $390 for the Smartmodem 1200. Equivalent prices today are $470 for the Smartmodem 2400 and $320 for the Smartmodem 1200. Prices on both modems have dropped, but more important, the differential between the two has dropped: from $210 to $150. (Current list prices for the Hayes models are $399 for the Smartmodem 1200, $599 for the Smartmodem 2400.) Less expensive modems, from other manufacturers, have even smaller differentials.

There's no doubt that there is a serious advantage to using an internal modem with a PS/2: it leaves the serial port free for some other purpose.

As the prices of 2,400-bps modems go down, the number of 2,400-bps modems to talk to increases. Additionally, all major on-line systems—including BRS, BRS/After Dark, CompuServe, Delphi, Dialog, Dow Jones News/Retrieval, Knowledge Index, Lexis, NewsNet, Nexis, and The Source, as well as data communication networks Telenet and Tymnet—are now equipped for 2,400 bps. If you transfer files often or download large chunks of information from on-line databases, a 2,400-bps modem can speed the transfer and save you time. And since communications time is literally money—in phone charges, data network charges, and on-line charges—a 2,400-bps modem can quickly pay for itself.

MO-DEM

As you probably already know, the word *modem*—short for MOdulator/DEModulator—takes its name from what it does. On the transmitting end, a modem takes computer-generated signals and modulates them, converting them to a form that can go over the phone network. On the receiving end, the modem takes the modulated signals and demodulates them, converting them back to a form that the computer can understand.

As you might expect, the more information a modem tries to cram into the phone line, the more likely it is for the information to be garbled. All other things being equal, a line problem that lasts a given length of time will do more damage at higher speeds: 1 second is long enough to ruin 30 characters at 300 bps or 120 characters at 1,200 bps.

The increase in difficulties at higher speeds shows up even when comparing 300- and 1,200-bps communications. But at these speeds, errors are few enough that they are usually not a problem for keyboard communications. During a file transfer, when even one error can ruin a file, error detection and correction is usually handled in software as part of the file transfer protocol.

At 9,600 bps, flow control problems become so pronounced that error-free communication is a practical impossibility. As a result, most of the manufacturers of 9,600-bps modems have developed their own, usually proprietary, error-correction protocols and built them into these high-speed modems.

There's less need for error correction in 2,400-bps modems. Nonetheless, many manufacturers have included a built-in error-handling scheme in some or all of their 2,400-bps modems.

Unfortunately, there is not yet any generally agreed-upon combination of communications protocol plus error-correction protocol for 2,400-bps modems—at least none that has won over the marketplace in the sense that the V.22 or Bell 212 standards have. However, there is hope in the relatively new V.42 error-correcting protocol. The standard is too recent to have had much effect, but as a CCITT recommendation supported by the market leader, Hayes, it offers promise.

It's worth noting that V.42 includes partial support for Microcom Networking Protocol (MNP) as an alternative protocol. MNP has been around for some time and is available in several modems, including four in this review. As with other communication protocols, error correction requires that both sides use the same techniques.

OS/2 NEWS

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CIRCLE 361 ON READER SERVICE CARD

FROM MORSE TO MODEMS: A BRIEF HISTORY OF TELECOMMUNICATIONS

1832 Samuel F. B. Morse's telegraph

1876 Alexander Graham Bell's telephone

by Joseph J. Antinori

When a curious artist fashioned a crude electrical device from his canvas stretcher in 1832, he kicked off the communications revolution. Since that time, at an ever-accelerating pace, men have set about eliminating the effects of distance. Today, with our comprehensive telecommunications networks and our modems, telephones, and fax machines, we are truly a global community.

Morse's invention led others to explore the potential uses of electricity. Improvements and innovations followed rapidly. Soon after the laying of the first cable, Kentucky schoolteacher David Hughes unveiled his device for automatically deciphering and printing messages received in Morse code. This grand era of invention was crowned by the introduction of the telephone at the Centennial Exposition in Philadelphia.

Modem technology is descended from the teletype of the early 1900s. After 1948, when computers began to appear, the need for data paths of a new kind presented itself. The first prototypes of modern-day modems arrived in the early 1950s.

The Bell Telephone monopoly dominated the modem market in this country until approximately 1975. End users had only two options for data communications: the Bell Data-Phone series and an "acoustic data coupler" from another manufacturer. This situation arose because Bell was the only company allowed by law to manufacture equipment that could plug into a phone jack. The acoustic data couplers had a "data access arrangement" with Bell: they were allowed to use a Bell handset to receive and transmit data.

The FCC ruling, in 1975, that eliminated the restrictions on outside manufacturers opened the door for true competition in the modem market. About the same time, Bell's dominance was also challenged in the arena of transmission coding and error-control standards. Previously, Bell's data sets had been de facto standards in this country and the CCITT standards used in the rest of the world had to include Bell compatibility. After 1976, CCITT recommendations began to take precedence, though most modems today support versions of both standards.

With the adoption of the V.42 standard in November 1988 and its universal endorsement by modem manufacturers, the foundation has been laid for continued innovation. We can expect still faster data transfer speeds and better data integrity as we continue to expand the possibilities for communications.

1950's

1954
110-bps British Telecom prototype of a modem in four modules

1956
Establishment of CCITT (International Telegraph and Telephone Consultative Committee), U.N. communications standards authority

1958
First Bell Data Phone system

1960's

1960
Bell 101A and 101C data sets: first standard data sets on switched lines (110 bps)

1961
Bell 201B and 202A data sets: 2,400 and 1,200 bps, respectively, half-duplex service

1963
Bell 103A data sets: 300-bps full-duplex operation standard

Acoustic data coupler

1968
Carterfone decision legalizing private ownership of phone equipment

1970's

1970
15,000 modems in operation using DAA (data access arrangement)

1975
FCC rulings allowing other manufacturers to build equipment plugging directly into the Bell Telephone system; end of the ecoustic data coupler and DAA

1976
Bell 212 data set: 1,200-bps full-duplex operation standard

1977
First Hayes modem

1980's

1980
250,000 modems in operation

CCITT V.22: 1,200-bps full-duplex world standard

1981
Hayes's AT command set introduced in the Smartmodem 300

1984
Divestiture of Bell Telephone monopoly

CCITT V.22 bis: 2,400-bps full-duplex standard

1987
10,000,000 modems in operation

1988
CCITT V.42: 9,600-bps full-duplex standard

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▣ package includes both 5¼" and 3½" disks.
◧ 3½" format available from manufacturer by request. Call us for details.
CP—copy-protected, **NCP**—not copy-protected.

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

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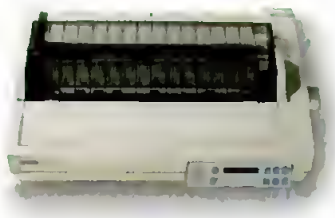
We only carry the latest versions of products. Version numbers in our ads are current at press time.

Aldus ... NCP
1332 ☐PageMaker 3.0 ..... call
Alpha Software ... NCP
4103 ▣AlphaWorks 1.0 ..... 99.
5104 ▣ALPHA/four 1.0 ..... 319.



Epson ... 1 year
LQ-2550 Printer–A full featured 24 pin, 136 column printer. Includes 7 built-in fonts, push tractor, and advanced paper handling. 333 cps draft, 111 cps LQ (12 cpi mode) ..... call

Application Techniques ... NCP
1214 ▣Pizazz Plus 1.2 ..... 75.
Ashton-Tate ... NCP
4450 ☐dBASE IV 1.0 ..... call
1309 ▣MultiMate Advantage II 1.0 .... 299.
Autodesk ... NCP
4519 ☐Autosketch Standard 1.04 ..... 55.
Best Programs ... NCP
1453 ☐Label Master 3.1 ..... 29.
Bible Research ... NCP
1464 ☐The Word 4.2 *(KJV or NIV)* ..... 159.
Bloc Publishing ... NCP
4796 ☐Personal Lawyer 2.0 ..... 39.
4801 ☐PopDrop 3.1 ..... 32.
1447 ☐FormTool 2.01 ..... 55.
4594 ☐Form Filler 2.0 ..... 89.
Borland International ... NCP
1527 ◧Superkey 1.18 ..... 69.
1498 ◧Turbo C 2.0 ..... 99.
4330 ◧Turbo C Prof. Pack 1.0 ..... 169.
4322 ◧Turbo Pascal 5.0 ..... 99.

Bloc Publishing ... NCP
☐*Form Tool 2.01*–Quickly and easily create any form on your PC. ..... $55.
☐*Form Filler 2.0*–The complete system for filling in any preprinted form quickly and accurately on any PC. ..... $89.

4332 ◧Turbo Pascal Prof. Pack 1.0 ..... 169.
4329 ◧Turbo Assembler & Debugger 1.0 99.
1525 ◧Sidekick Plus 1.0 ..... 135.
1526 ◧Sprint 1.0 ..... 135.
1521 ◧Quattro 1.01 w/SQZ!Plus 1.0 ... 165.
1514 ▣Paradox 3.0 ..... call
Bourbaki ... NCP
4524 ☐1DIR + 3.02 ..... 49.
Bridgeway Publishing ... NCP
4386 ☐FastTrax 3.9 ..... 35.
Broderbund ... CP
1434 ☐Print Shop 2.41 ..... 39.
1433 ▣Memory Mate 3.01R *(NCP)* ..... 45.
Central Point ... NCP
5039 ▣PC Tools Deluxe 5.5 *(new version)* 79.
5038 ☐Copy II PC 5.0 ..... 24.
Chronos Software ... NCP
4387 ◧Who•What•When 1.09 ..... 119.
Computer Associates ... NCP
4934 ▣SuperCalc 5 1.0 ..... 319.
Core International ... NCP
1571 ☐Corefast 2.0 ..... 95.
Crosstalk Communications ... NCP
2911 ☐Remote² 1.1 ..... 95.
2908 ☐Crosstalk XVI 3.7 ..... 95.
2909 ☐Crosstalk MK.4 1.1 ..... 124.
Dac Software ... NCP
1754 ☐Dac Easy Light 1.0 ..... 45.
1756 ☐Dac Easy Payroll 3.0 ..... 59.
1748 ☐Dac Easy Accounting 3.0 ..... 59.
Data Storm ... NCP
4798 ☐PROCOMM PLUS 1.1B ..... 49.
Delrina Technology ... NCP
4325 ▣Per:FORM 2.0 *(new version)* ... 179.
5th Generation ... NCP
3950 ▣Fastback Plus 2.09 ..... 109.
Fox Software ... NCP
2233 ◧Foxbase Plus 2.1 *(single user)* .. 209.
Funk Software ... NCP
2228 ☐Sideways 3.21 ..... 42.
2229 ▣Worksheet Utilities 1.0 ..... 59.
4479 ☐Allways 1.0 ..... 85.
General Information ... NCP
4118 ◧Hot Line Two 2.1 ..... 49.

Generic Software ... NCP
2264 ◧Basic Home Design 3.0 ..... $35.
4344 ◧Generic CADD Level 2 1.1 ..... 89.
4584 ◧CADD Starter Kit 1.0 *(incl. Level 2)* 109.
2265 ◧Generic CADD Level 3 1.1 ..... 179.
Great American Software ... NCP
4880 ☐The Accounting System 2.0 ....179.
4879 ☐Payroll 2.05 ..... 89.
Harvard Associates ... NCP
2324 ◧PC Logo 3.0 ..... 59.
Hayes ... NCP
2293 ▣Smartcom II 3.0 ..... 89.
2295 ▣Smartcom III 1.0 ..... 149.
Hilgraeve Software ... NCP
2323 ☐HyperACCESS 3.31 ..... 89.
Individual Software ... NCP
2415 ▣Typing Instructor Encore 2.13 .... 19.
2408 ☐Professor DOS 2.51 ..... 27.
Intuit ... NCP
2426 ▣Quicken 2.1 ..... 35.
Javelin ... NCP
2526 ◧Javelin Plus 2.03 ..... 249.
Lord Publishing ... NCP
5191 ▣Ronstadt's Financials 1.01 ..... 125.
Lotus ... NCP
2668 ☐1-2-3 2.01 ..... call
5134 ☐Magellan 1.0 *(introductory offer)* . 99.
2662 ☐HAL 1.0 ..... 109.
4131 ▣Agenda 1.0 ..... 275.
2660 ☐Freelance Plus 3.0 ..... 345.
2667 ☐Symphony 2.0 ..... 459.
MECA ... NCP
4529 ▣Chackwrite Plus 1.0 ..... 29.
2798 ☐Managing Your Money 5.0 ..... 119.
Meridian Technology ... NCP
2775 ☐CarbonCopy Plus 5.0 *(2 req.)* ... 115.
Micro Logic ... NCP
2968 ☐Tornado 1.8 ..... 55.
Microlytics ... NCP
2734 ☐WordFinder 4.0 ..... 39.
2731 ☐GOfer 1.0 *(text retrieval system)* .. 45.
MicroPro ... NCP
2825 ☐WordStar Prof. Release 5.5 .... 209.
5000 ☐*Upgrade to Release* 5.5 ..... 89.

Lord Publishing ... NCP
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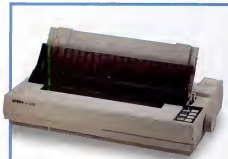
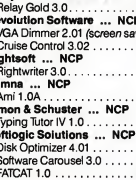


Epson ... 1 year
FX-1050 Printer–Feature laden 136 column, 9 pin dot-matrix printer. SmartPark mode loads single sheets without removing continuous form paper. Prints 264 cps draft and 54 cps letter quality (12 cpi mode) ..... call

Microrim ... NCP
2835 ⊞R:BASE for DOS *(version 2.1)*. . $489.
5008 ⊞R:BASE Compiler 1.0 ..... 629.
Microsoft ... NCP
2860 □Learning DOS 2.0 ..... 35.
2899 □Windows 286 2.1 ..... 69.
2904 □Works 1.05 *(with Checkwrite Plus)* 99.
2900 ⊞Windows 386 2.1 ..... 129.
2890 ⊞Multiplan 4.01 ..... 135.
2901 ⊞Word 5.0 ..... call
2856 ⊞Excel 2.1 *(req. 80286/80386)*. . . 239.
2891 ⊞Project 4.0 ..... 329.
LANGUAGES
5188 □Quick Pascal 1.0 ..... 49.
2894 □Quick BASIC 4.5 ..... 69.
2895 □Quick C 2.0 ..... 69.
2880 ⊞Macro Assembler 5.1 ..... 99.
2847 ⊞Basic Compiler 6.0 ..... 199.
2859 ⊞Fortran Compiler 5.0 ..... 289.
2853 ⊞C Compiler 5.1 ..... 299.
Monogram ... NCP
2778 ⊞Dollars and Sense 3.1 ..... 105.
Multisoft ... NCP
4924 □Super PC-Kwik 3.2 ..... 49.
4925 □PC-Kwik Power Pak 1.1 ..... 79.
Nantucket Software ... NCP
2970 ⊞Clipper *(Summer '87)* ..... 429.
New England Software ... NCP
3004 ⊞Graph-in-the-Box 2.2 ..... 75.
4337 □GB-Stat 1.0 ..... 159.
4336 ⊞GB Analytic 1.0 ..... 105.
Noio Press ... NCP
2982 □WillMaker 3.0 ..... 35.
5122 □For The Record 1.0 ..... 35.
North Edge Software ... NCP
2987 □Timeslips III 3.3 ..... 169.
Norton-Lambert ... NCP
4928 □Close-Up Customer 3.0 ..... 135.
4929 □Close-Up Support 3.0 ..... 165.
Owl International ... NCP
3080 □Guide 2.0 ..... 143.
Paperback Software ... NCP
3142 □VP-Planner Plus 2.0 ..... 145.
3138 □VP-Expert 2.02 ..... 145.
Paul Mace ... NCP
2762 □Mace Utilities 5.0 *(DOS utilities)* . $55.
4688 □Mace Gold 1.0 ..... 79.
PC Support Group ... NCP
3208 □Lightning 4.82 ..... 39.
3209 □Lucid 3-D 2.0 ..... 59.
Persona ... NCP
3126 □SeeMORE 1.02 ..... 49.
4328 □Look & Link 1.04 ..... 59.
4384 □Ultravision 1.1 ..... 79.
3124 □ATBASE 1.22 ..... 119.
Peter Norton ... NCP
3152 ⊞Norton Commander 2.0 ..... 52.
3146 ⊞Advanced Utilities 4.5 ..... 89.
4150 ⊞Dan Bricklin's Demo Prog. 2 1.0 109.
Quarterdeck ... NCP
3221 □Expanded Memory Mgr. 386 4.2 . 39.
3220 □DESQview 2.24 ..... 79.
4586 □DESQview 386 1.0 ..... 115.
Reference Software ... NCP
4396 □Grammatik III 1.07 ..... 52.
Relay Communications ... NCP
4651 □Relay Gold 3.0 ..... 149.
Revolution Software ... NCP
4480 ⊞VGA Dimmer 2.01 *(screen saver)* . 19.
3254 ⊞Cruise Control 3.02 ..... 39.
Rightsoft ... NCP
4155 □Rightwriter 3.0 ..... 54.
Samna ... NCP
5148 □Aml 1.0A ..... 129.
Simon & Schuster ... NCP
3314 □Typing Tutor IV 1.0 ..... 33.
Softlogic Solutions ... NCP
3546 □Disk Optimizer 4.01 ..... 45.
3542 □Software Carousel 3.0 ..... 49.
4855 ⊞FATCAT 1.0 ..... 69.



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□*Timeslips III 3.3*–Track every minute's efforts, then print the invoice and log the receivable all from the convenience of Timeslips III. Menu-driven and memory resident, this is a must for your service business ..... $169.

Software Publishing ... NCP
3495 ⊞Professional Plan 1.02 ..... $59.
3499 □PFS:First Publisher 2.1 ..... 79.
4342 ⊞PFS:First Graphics 1.0 ..... 89.
3478 ⊞PFS:First Choice 3.01 ..... 99.
3496 ⊞Professional Write 2.1 ..... 139.
3493 ⊞Professional File 2.0 ..... 189.
4527 ⊞Office Writer 6.1 ..... 299.
3482 ⊞Harvard Graphics 2.12 ..... 299.
4669 ⊞Harvard Graphics Access. Pk 1.0 289.
4284 ⊞Harvard Project Manager 3.0. . . 409.
Spinnaker ... NCP
4441 □Resume Kit 1.29 ..... 25.
4444 ⊞Splash 1.0 ..... 59.
Springboard ... NCP
3534 ⊞Newsroom Pro 1.0 ..... 45.
Symantec ... NCP
4732 ⊞SQZ!Plus 1.11 ..... 65.
3430 ⊞Think Tank 2.41 ..... 125.
3427 ⊞Q & A Write 1.01. ..... 129.
3412 ⊞Grandview 1.0 ..... 189.
3425 □Q & A 3.0 ..... 219.
3431 □*Breakthrough* Timeline 3.0. . . . . 369.

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4179 ⊞ClickArt Business Images ..... 42.
4185 ⊞Scrapbook+ 1.0 ..... 79.
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4512 ⊞XTREE Pro 1.1 ..... 69.
TOPS ... NCP
3724 ⊞NetPrint 2.0 *(share printers)* .... 119.
3726 ⊞TOPS 2.1 ..... 119.
3725 TOPS Repeater *(extends network)*. 129.
3720 *Flashcard 2.1 (AppleTalk network card; 1 year warranty)* ..... 169.
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4190 Battery Watch 1.0 *(3½" only)* .... 27.
3729 ⊞LapLink Mac 2.0 *(Mac-PC transfer)* 79.
5179 ⊞LapLink III ..... 85.
4891 ⊞ViewLink 1.0 ..... 95.
3727 ⊞DeskLink 2.21 ..... 99.
True BASIC, Inc. ... NCP
3561 ⊞True BASIC 2.1 ..... 57.
Vericomp ... NCP
3765 ⊞SoftBytes 2.0 ..... 35.

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3804 □WordPerfect 5.0 ..... 239.
3805 ▣WordPerfect Network 5.0 ..... 349.
3806 ▣Additonal Network Stations 5.0 .. 84.
Wordtech ... NCP
3810 □DBXL 1.2 ..... 119.
Xerox ... NCP
3812 □Ventura Publisher 2.0 ..... call
XYQUEST ... NCP
4393 □XyWrite III Plus 3.55 ..... 229.

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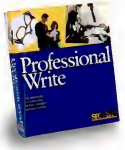
1413 □Where in the World is Carmen Sandiego? ..... 25.
1414 □Where in the USA is Carmen Sandiego? ..... 25.
1417 □Where in Europe is Carmen Sandiego? ..... 29.
4948 ▣JetFighter *(by Velocity)* ..... 35.
Electronic Arts ... CP
5180 ▣Dinosaur Discovery Kit *(First Byte)* 29.
5182 ▣Puzzle Story Book *(from First Byte)* 32.
1858 ▣Earl Weaver Baseball 1.5 ..... 32.
5181 ▣Hillsfar *(from SSI)* ..... 32.
1839 ▣Chuck Yeager's Flight Trainer 2.0.. 35.
Microprose ... CP
4454 □F-19 Stealth Fighter ..... 39.
2725 □F-15 Strike Eagle ..... 22.
Microsoft ... NCP
2858 □Flight Simulator 3.0 ..... 35.
Mindscape ... CP
4897 □Gauntlet ..... 29.
4625 Colony *(3½" not available)* ..... 33.
2752 ▣Balance of Power 1990 ..... 33.
Perlor Software ... CP
3159 □Bridge Parlor 2.3 ..... 49.
Sierra On-Line ... CP
4752 ▣Gold Rush ..... 25.
4455 ▣Leisure Suit Larry II ..... 33.
4345 ▣King's Quest IV *(512k version)* ... 33.
4399 ▣Manhunter ..... $33.
4456 ▣Police Quest II ..... 33.
3404 ▣Space Quest II ..... 33.
Spectrum Holobyte ... NCP
3467 ▣Tetris *(addicting mind teaser)* .... 24.
4283 ▣Falcon/AT *(F-16 simulation)* 39.
5187 ▣VETTE! ..... 32.
Stone & Assoc. ... NCP *(reqs. graph. brd.)*
3436 ▣Memory Master *(ages 2-6)* ..... 22.
3435 ▣My Letters,Numbers,Words *(2-6)* 22.
3439 □2nd Math *(ages 7-16)* ..... 27.
Sublogic ... NCP
4653 □Up Periscope ..... 25.
3335 □Jet *(requires CGA or EGA)* ..... 33.
True BASIC, Inc. ... NCP
▣Kemeny/Kurtz Math Series each module ..... 32.



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▣*Professional Write 2.1*–Now with new Preview feature that shows you exactly how a document is going to look–before you print. Read and write files directly then print them out on most any printer ..... $139.

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Manufacturer's standard limited warranty period for items shown is listed after each company neme. Some products in their line may have different warranty periods.

AST Research ... 2 years
1223 I/O Mini 2 C/S/P ..... 89.
1302 SixPakPlus 64k C/S/P ..... 129.
4107 RAMpage Plus 286 512k. ..... 419.
4105 RAMpage Plus MicroChannel 512k 469.
Compucable ... 2 years
1604 2-Position switch box ..... 29.
1605 3-Position switch box ..... 39.
Cuesta ... 1 year
1608 Datasaver 400 Watt *(standby power backup)* ..... 429.
Curtis ... lifetime
1681 Curtis Clip CC-1 ..... 6.
1686 Disk Holder DB-1 ..... 8.
1718 3½" Disk Holder DB-2 ..... 8.
1704 Printer Stand PS-1. ..... 18.
1713 Filtered SafeStrip SPF-3 ..... $24.
1678 Universal System Stand SS-3 ..... 25.
1694 Emerald SP-2 ..... 36.
1707 Ruby SPF-2
(6 outlets; EMI/RFI filtered; 6 ft cord) 55.
1708 Ruby-Plus SPF-2 Plus
(w/FAX & modem protection) ..... 69.
DCA ... 1 year
1761 Irma 2 *(3270 emulation board)* ... 729.
1764 Irma 2 Micro Channel ..... 729.
Epson ... 1 year
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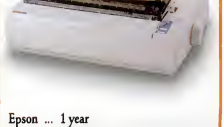
1906 FX-850 *(80 col., 264 cps, 9 pin)* ... call
1904 FX-1050 *(136 col., 264 cps, 9 pin)*.. call
5183 LQ-510 *(80 col., 180 cps, 24 pin)*.. 349.
1930 LQ-850 *(80 col., 264 cps, 24 pin)* .. call
4117 LQ-950 *(110 col., 220 cps, 24 pin)*.. call
1917 LQ-1050 *(136 col., 264 cps, 24 pin)* call
4116 LQ-2550 *(136 col., 333 cps, 24 pin)* call
5184 LX-810 *(80 col., 180 cps, 9 pin)* ... 199.
1052 Printer-to-IBM cable *(6 feet)*..... 15.
Everex ... 1 year
2029 1200 Baud Internal Modem ..... 79.
2030 2400 Baud Internal Modem ..... 149.
5th Generation ... 1 year
3952 Logical Connection 512k..... 529.
4921 Logical Connection 1 Meg ..... 749.
Hayes ... 2 years
4763 Personal Modem 1200 *(with Smartcom EZ)* ..... 145.
2304 Smartmodem 1200 ..... 289.
2305 Smartmodem 1200B *(w/Smartcom II)* 289.
2307 Smartmodem 2400 ..... 429.
2308 Smartmodem 2400B *(w/Smartcom II)* 429.
Hercules ... 2 years
2318 Graphics Card Plus..... 189.
Intel ... 5 years
4696 2400B Internal Modem..... 159.
2352 2400B Internal Modem 2 *(for PS/2)* 249.
5119 2400 Baud External Modem..... 179.
2346 Inboard 386/PC w/1 Meg ..... 599.
4646 Inboard 386/PC Piggyback 4 Meg 1249.
2339 Inboard 386/AT *(req. inst. kit)* .... 859.



Epson ... 1 year
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4272	Above Board 2 Plus 512k	469.
4339	Above Board Plus Piggyback w/2 Meg *(upgrades to 6 Meg)*	call
4275	Connection Coprocessor	769.
4857	Visual Edge *(improve the output of your HP LaserJet II)*	449.
	MATH COPROCESSORS	
2375	8087 *(for IBM-PC & XT)*	95.
2374	8087-2 *(for 8 MHz 8088 CPU's)*	139.
2368	80287 *(for 6 MHz 80286 CPU's)*	149.
2370	80287-8 *(for 8 MHz 80286 CPU's)*	219.
2369	80287-10 *(for PS/2 Models 50 & 60)*	259.
4750	80387SX *(for 80386SX CPU's)*	359.
2371	80387 *(for 16 MHz 80386 CPU's)*	399.
2372	80387-20 *(for 20 MHz 80386 CPU's)*	459.

Kensington Microware ... 1 year

2581	Masterpiece	94.
2582	Masterpiece Plus	109.
4972	PowerTree 10	19.
4973	PowerTree 20	29.
4974	PowerTree 50	59.

Reference Software ... NCP

☐*Grammatik III 4.07*–Gives your writing power, gives you confidence. Correct grammatical errors and style problems with Grammatik III's on-line editor. Works with over 35 different word processors .... **$52.**

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2537	101 Keyboard	99.
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Kraft ... 5 years

2603	Three-button Joystick	33.
2597	High Speed Joystick Adapter Card	25.

KYE International ... lifetime

4127	Dyna Mouse GM6+ *(w/Dr. Halo III)*	49.
4675	GM6000 Mouse *(350-1050 dpi)*	59.

Logitech ... lifetime

4145	Series 2 Mouse *(for PS/2's)*	65.
4388	ClearCase Mouse *(serial only)*	69.
5151	New HiREZ Mouse *(C9)*	89.
5152	Mouse w/Paint Show *(C9)*	99.
4297	ScanMan *(hand held scanner)*	219.

Magnavox ... 2 years

5051	VGA Adapter *(9AV610)*	259.
4758	13" CGA Monitor *(8CM515)*	269.
4760	13" Hi-Res Monitor *(9CMO53)*	369.
4761	13" VGA Monitor *(9CMO62)*	389.
4762	13" VGA Monitor *(9CMO82)*	449.

Intel ... 5 years

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Microsoft ... 2 years

2870	Mach 20 *(1 yr. wrty., includes free PCTV installation video)*	349.
2886	Mach 20 Disk Plus Option *(floppy controller)*	69.
2887	Mach 20 Memory Plus Option *(512k upgradeable to 3.5 Meg)*	339.
2897	Mouse with Paintbrush	109.
2896	Mouse with Easy CAD	125.
2898	Mouse with Windows 286 2.1	139.

Mouse Systems ... lifetime

2812	OmniMouse *(serial only; 1 year wrty)*	49.
4306	PC Mouse II w/PC Paint+	89.
4350	PC Mouse II w/Autosketch	105.

NEC ... 2 years

4677	Multispeed HD Laptop Computer	call
4799	Multisync 2A *(VGA Monitor)*	499.
5085	Multisync 3-D Monitor	699.

Orchid Technologies ... 4 years

3069	Tiny Turbo 286 *(accelerator board)*	219.
4690	ProDesigner VGA *(800 x 600)*	319.

Pacific Rim ... 1 year

5010	1.2 Meg External *(for PS/2's)*	215.
5011	360k External 5¼" Drive	179.

PC Power & Cooling Sys. ... 1 yr

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3202	Turbo Cool 150 *(25° - 40° cooler)*	129.
3205	Turbo Cool 250 *(25° - 30° cooler)*	169.
3200	Silencer 150 *(84% noise reduction)*	115.
3201	Silencer 200 *(69% noise reduction)*	149.
4514	Turbo Cool 375	299.

PC Support Group ... 1 year

3211	Breakthrough 286-8 *(8 MHz accelerator)*	289.
3210	Breakthrough 286-12 *(12 MHz accelerator)*	429.

Practical Peripherals ... 5 years

3101	1200 Baud Internal Modem *(with PROCOMM)*	$69.
3100	1200 Baud External Modem *(mini)*	79.
4149	PiLink *(extends par. print signal)*	109.
3097	Microbuffer Inline *(par. print buffer/32k)*	135.
3103	2400 Baud Internal Modem *(with PROCOMM)*	139.
3102	2400 Baud External Modem	179.
4542	2400 Baud Internal Modem for PS/2	229.

Princeton Graphics ... 1 year

3166	Ultrasync *(800 x 600 max. res.)*	549.
5189	Ultra-16 Monitor *(16" 1024 x 768 maximum resolution)*	899.

Quadram ... 1 year

5143	JT-FAX 9600	549.

Safe Power Systems ... 2 years

4561	Safe 250W *(standby power bkup)*	249.
4562	Safe 425W *(standby power bkup)*	369.
4563	Safe 500W *(standby power bkup)*	495.

SOTA Technology ... 2 years

5111	SOTA 286i-12 *(12 MHz accelerator)*	339.
5109	SOTA VGA/16 *(with 256k)*	339.

Targua ... lifetime

4899	Nylon Laptop carrying case	55.
4901	Leather Laptop carrying case	139.

TheComplete PC ... 2 years

4889	TheComplete Hand Scanner 400	169.
4885	TheComplete Answering Machine	239.
4887	TheComplete FAX 9600	449.
5140	TheComplete Page Scanner	589.

Toshiba ... 1 year

3684	T1000 Laptop *(80C88, 6.4 lbs.)*	call
4856	T3100E Laptop *(80286, 12 MHz, 20 Meg)*	2849.
4958	T1600 Laptop *(80C286, 12 MHz, 20 Meg)*	3349.

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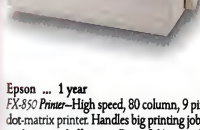
4193	FastWrite VGA *(includes 256k)*	319.
4194	VRAM VGA *(includes 256k)*	469.



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IOMEGA ... 1 year

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5116 Bernoulli II Single 44 Meg Internal 995.
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4276 20 Meg Cartridge Tripak *(5¼")* . . . 169.
5113 44 Meg Cartridge Tripak *(5¼")* . . . 259.
2499 PC2 Card . . . . . 169.
2500 PC2B Card *(bootable card for PC/XT/AT)* . . . . . 229.
2502 PC4 Card *(for PS/2 Model 50/60/70/80)* . . . . . 299.

Mountain Computer ... 1 year

2917 40 Meg Internal Tape Drive . . . . . 379.
2915 40 Meg External Tape Drive . . . . . 479.
2916 40 Meg External Tape Drive with Power Supply . . . . . 569.
5190 40 Meg Data Cartridges *(pre-formatted)* . . . . . 25.

Plus Development ... 2 years

3105 Hardcard 20 Meg *(49 ms)* . . . . . 549.
3106 Hardcard 40 Meg *(28 ms)* . . . . . 699.
5164 Impulse 40 Meg Int. Drive *(12 ms)* 679.
5165 Impulse 80 Meg Int. Drive *(12 ms)* 899.
5163 Impulse Controller *(required)* . . . . 229.

Seagate ... 1 year

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2286 30 Meg Internal Hard Drive ST238 *(w/controller and cables, 65 ms)* . . 329.
2281 40 Meg Internal HD ST251 for AT *(40 ms)* . . . . . 399.
2287 40 Meg Internal HD ST251 for XT *(w/controller and cables, 40 ms)* . . 449.
4554 40 Meg Internal HD ST251-1 for AT (28 ms) . . . . . 449.
4624 80 Meg Internal HD ST4096 for AT (28 ms) . . . . . 649.

TEAC ... 1 year

4950 PC, XT 360k Drive *(5¼")* . . . . . $79.
4951 720k Drive *(specify XT or AT, 3½")* . 79.
4670 1.44 Meg Drive for XT *(3½")* . . . . . 99.
4326 1.44 Meg Drive for *AT (includes Bastech software utilities, 3½")* . . . . . 119.

Toshiba ... 1 year

3650 AT 360k Drive *(5¼")* . . . . . 85.
3649 AT 1.2 Meg Drive *(5¼")* . . . . . 99.
4755 AT 1.44 Meg Drive *(3½", includes Bastech software utilities)* 119.

MISCELLANEOUS

CompuServe

1676 CompuServe Information Service . . 24.

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1050 Parallel Printer cable *(15 feet)* . . . . 19.

Epson ... 1 year

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3291 Sony *(10 disks per box)* . . . . . 12.
2789 Maxell MD2-D *(10 disks per box)* . . 13.
4192 Verbatim Datalife *(10 disks per box)* . 13.

5¼" DS/High Density Disks *(1.2 Meg)*

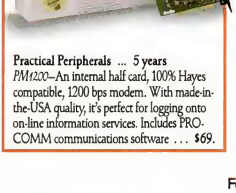
2212 Fuji MD2HD *(10 disks per box)* . . . . 22.
3770 Verbatim Datalife *(10 disks per box)* . 22.
3292 Sony *(10 disks per box)* . . . . . 23.
2790 Maxell MD2-HD *(10 disks per box)* . 23.

3½" DS/DD Diskettes *(720k)*

3297 Sony *(10 disks per box)* . . . . . 16.
2214 Fuji *(10 disks per box)* . . . . . 17.
3772 Verbatim *(10 disks per box)* . . . . . 17.
2792 Maxell *(10 disks per box)* . . . . . 17.

3½" DS/High-Density Diskettes *(1.44 Meg)*

3298 Sony *(10 disks per box)* . . . . . 39.
2215 Fuji *(10 disks per box)* . . . . . 39.
2793 Maxell *(10 disks per box)* . . . . . 39.



Practical Peripherals ... 5 years

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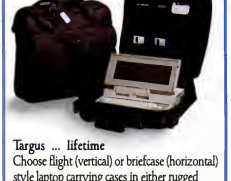

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BAUD VS. BPS

The terms *baud* and bits per second are often used interchangeably, but they shouldn't be. In some cases they are equal—300 bps can equal 300 baud—but under the V.22 bis protocol, 2,400 bps does not equal 2,400 baud. While bps refers to the number of bits a modem can transfer per second, baud is a count of the number of signalling elements. If a given protocol defines one bit per baud, the two numbers will be the same. If it defines more than one bit per baud, they will be different. The V.22 bis protocol uses a technique called Quadrature Amplitude Modulation (QAM) that results in four bits per baud; with it 2,400 bps equals 600 baud.

CHOICE IN PS/2 MODEMS

Though they may be more difficult to develop, Micro Channel modems are no different in any important respect from their equivalents for the classic PC or AT bus. Of this group, all but the Hayes Smartmodem 2400P are strictly asynchronous—appropriate for the vast majority of PC-based communication. However, if you need to communicate with a V.22 bis synchronous modem (attached to a company mainframe, for example), take a look at the Hayes modem.

As asynchronous modems, these modems offer both automatic and manual dialing and answering. All offer blind dialing and all offer call-progress-monitoring features like dial-tone, busy-signal, and voice detection. All have two modular phone connectors on-board. All offer on-board memory for storing setups, and all but one allow you to store phone numbers in memory.

Almost half of these modems use the popular Rockwell chip set, but other chip sets are represented as well, including Intel, Exar, and SSI. (The chip set is the actual modem on each board, typically consisting of two or three chips. Boards that use the same chip set will tend to have similar performance.) The Hayes and Octocom modems use proprietary chips. All use some variation of the Hayes AT command set (see the sidebar, "In Search of Hayes Compatibility"). The Octocom follows the CCITT V.25 command set as well.

Most other differences among the modems are best described as minor idiosyncrasies. For example, most use software commands for volume control, but one uses a manual control on the back of the board, as did older PC modems. Most use the speaker on the PS/2 to monitor call progress, but two have their own speakers, again like the older PC modems. Most set all configuration options from the keyboard, using firmware commands or settings available through the Adapter Definition File.

Picking the right Micro Channel modem is no different from picking the right AT-bus modem. First find those with the communications protocols and features you need, then choose one based on a combination of performance and cost. And when figuring your budget, don't forget to add the price of a communications program if the modem isn't bundled with one. Most of the modems offer only the most-common communication features, but there is enough variation to give you a decent number of choices.

ANCHOR AUTOMATION INC.

Anchor 2400PS

by Ross M. Greenberg

The least expensive of these PS/2 modems, the $279 Anchor 2400PS offers everything the majority of its peers do. It stands out from the pack because it is one of the few to come with a speaker and volume control on its board instead of using the PS/2's speaker and controlling it through software.

Installing the 2400PS is a breeze, and its documentation is adequate. The modem has a 16-bit extension on-board and comes with Anchor's proprietary communications package, *AnchorTalk*. If, however, you'd prefer to use it with *Crosstalk XVI*, *Smartcom II*, *Smartcom III*, *Relay Gold*, or *Lotus Express*, it'll work fine with any of them.

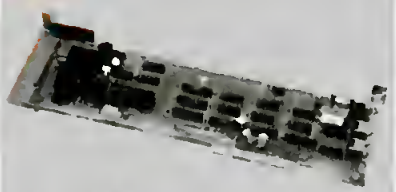
The Anchor 2400PS is the least expensive of these PS/2 modems. Its performance on our tests was the worst of the group, but still far better than all of the modems that ended up not being reviewed.

The modem's performance on our automated line tests was the worst of the group, but it did far better than all of the modems that ended up not being reviewed because of performance on the TAS test. It should perform acceptably on a variety of line conditions.

The modem does have its quirks. The only one that can get in the way of typical communications programs is its problem with the A/ command. Typically used when the number you call is busy, this command repeats the last command issued. The 2400PS's documentation warns you that the A/ command will work "unless the last command was a dialing command, the number being dialed was lengthy, and a modem handshake was attempted." In our testing of the modem, however, we found that the problem was less predictable than the manual indicates. This can limit the versatility of the modem, especially if you're trying to log on to a particularly busy bulletin board system, or if you have some hefty line-noise problems.

Some of the attributes other modems use for setting, retrieving, and storing different user profiles are also lacking in this modem. For example, while many of the other modems tested had some means for

FACT FILE



Anchor 2400PS
Anchor Automation Inc., 2067S Bahama St., Chatsworth, CA 91311; (818) 998-6100.
List Price: $279
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible.
In Short: The Anchor 2400PS is an inexpensive modem with a few quirks. Its inability to consistently implement one of the commands of the AT command set could prove problematic.

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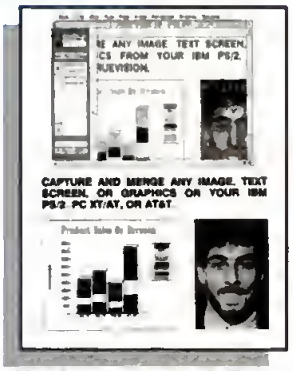

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IBM PS/2 VGA and MCGA

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AT&T 6300 Display Adapter Cards: Image Capture Board (ICB), Truevision TARGA 16, DEB
PRINTERS: Adobe Systems PostScript, **Alps** ALQ200 (18 and 24 pin), ALQ300 (18 and 24 pin), P2400C (18 and 24 pin), **AMT** Office Printer, **Anadex** 9625B, 9725, S7024, S7024C, **AST** TurboLaser/PS, **AT&T** 477, **C. Itoh** 1550 Prowriter, 8510, 8510BP1, 8510SC, C-310 CXP, C-315 CXP, C-715A (LQ-1000), **CalComp** ColorMaster, ColorView 5912, PlotMaster, **Canon** A1210, PJ-1080A, **Centronics** 250, 260, 358, 359, **CIE** LIPS 10, **Citizen** MSP-20, MSP-25, **Dataproducts** 8000, 8001, 8002, 8010, 8011, 8012, 8020, 8021, 8022, 8050, 8051, 8052, 8070, 8070 Plus (IBM), 8070 Plus (P-Series), 8071, 8072, M-480, P-80, P-132, **Diablo** C150, **Epson** DFX-5000, EX-800, EX-1000, FX-80, FX-85, FX-86e, FX-100, FX-185, FX-286, FX-286e, FX-850, FX-1050, GQ-3500, GQ-3500 (1.5Mb), HS-80, JX-80, LQ-800, LQ-850, LQ-950, LQ-1000, LQ-1050, LQ-1500, LQ-2500, LQ-2550, LX-80, LX-90, LX-800, MX-80 w/Graftrax, MX-100 w/Graftrax, RX-80, RX-100, SQ-2000, **Fujitsu** DL2400, DL2600, DL3300, DL3400, DotMax 24C, DPL24C, DX2100, DX2200, **Genicom** 1000 (Epson), 1000 (IBM), 3310, **Hewlett Packard** LaserJet, LaserJet+, LaserJet Series II, PaintJet, ThinkJet (Epson MX-80 Mode), **IBM** Color Jetprinter, Graphics Printer, PC Color Dot Matrix, ProPrinter, ProPrinter XL, Quietwriter 5201-002, **IDS** Microprism, Prism 80, Prism 132, **Infoscribe** 1200, **JDL** 850, **NEC** CP6, CP7, LC-800, P2200, P5, P5XL, P5200, P5300, P6, P7, P9XL, **Newbury** Data OSP-2, OSP-3, **Oasys** LaserPro 810-R, **Okidata** Laserline 6, Microline 82, 83, 84, 92, 93, Microline (Plug&Play) 82, 83, 84, 92, 93 Microline (IBM) 182, 192, 193, Microline 292, 293, 294, 320, 321, Microline (IBM) 292, 293, 294, 320, 321, 390, 391, 393, Okimate-20, **Panasonic** KXP-1080i, KXP-1091, KXP-1091i, KXP-1092, KXP-1092i, **KXP-1093**, KXP-1524, KXP-1592, **Printronix** S7024, S7024C, **QMS** PS 800, **PS** 800 Plus, **PS 800 II, Quadram** Quadjet, QuadLaser, **Qume** LaserTEN Plus, **Seikosha** SPC-700, **Star Micronics** Delta-10/15, Gemini-10X/15X, NX-10 (IBM), Radix-10/15, SD-10/15 (IBM), SG-10/15 (IBM), SR-10/15 (IBM), **Tandy** (Radio Shack) CGP-220, **Tektronix** 4693D 4695, 4696, **Toshiba** P321, P321SL, P351, P351C, P351SX, P1340, P1351, **Transtar** 315, **Xerox** 4020.

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viewing the current setting of the modem and its registers, the Anchor modem does not offer such a command. This can make setting the modem for peculiar systems a bit of a pencil-and-paper exercise.

If it were able to implement the A/ command properly, the Anchor 2400PS would be a perfectly reasonable modem. As it stands, its bargain-basement price is the best reason to buy it.

ANDERSON JACOBSON

AJ 2412-3H1

by M. David Stone

If you were to list the absolute minimum capabilities you expect from a 2,400-bps PS/2 modem, you would probably wind up with something resembling Anderson Jacobson's AJ 2412-3H1. That's not to say there's anything wrong with or missing from this $449 modem. It's just that there are no extras that make it stand out from the crowd.

As with most PS/2 modems, the AJ 2412-3H1 provides for asynchronous communications only. Protocols and speeds are just what you would expect: the Bell 103 protocol at 0 to 300 bps, the Bell 212 and V.22 at 1,200 bps, and the V.22 bis at 2,400 bps.

One of the features you should also expect in any modem is that it take its marching orders from AT commands, and the AJ 2412-3H1 command set is in fact a fairly close match of the commands for the Hayes Smartmodem 2400B or 2400P. Missing from the modem are some of the later-generation Hayes commands—like &V for viewing the current configuration and the commands for storing and retrieving more than one phone number or configuration profile. But you won't find these on early versions of the Smartmodem 2400, either, and their absence won't interfere with the modem's ability to work with a program designed for it.

Also missing from the strictly asynchronous AJ 2412-3H1 are the commands that Hayes uses for synchronous communications. (Of this batch of Micro Channel modems, only the Hayes supports synchronous communications.) Somewhat surprisingly, the modem responds to at least some of these commands with an "OK" but with no effect on the modem's behavior. As you might expect in a minimalist modem, the AJ 2412-3H1 has no additional commands of its own.

In tests with communications programs, the AJ 2412-3H1 worked without special tweaking with *Smartcom II*, *Smartcom III*, and *Relay Gold*, as well as with more-forgiving programs such as *Lotus Express*, *ProComm*, and *Crosstalk XVI*. Odds are it will handle nearly any communication program installed for a Hayes 2400.

The manual for the AJ 2412-3H1 is merely adequate. The 8½- by 11-inch format is somewhat clumsy for quick reference, and the print quality looks like a moderately good photocopy of typewritten instructions. A command index conveniently lists all modem commands and refers to the proper pages for further information, but the format makes it difficult to match the page reference to the command. The explanations themselves are reasonably clear, although (as with most modem manuals) they assume you know enough to make sense out of statements like, "This command allows the CD (Carrier Detect) signal to be forced ON to the connected DTE (Data Terminal Equipment)."

Installation is typical of PS/2 modems, with all configuration options set from the keyboard. The only settable option in the Adapter Definition File is for comm ports one through eight. All other settings are through AT commands.

As should be clear, the AJ 2412-3H1 is a plain-vanilla 2,400-bps modem. If you're looking for any unusual features, you won't find them here. But if you want basic asynchronous communication capabilities in a PS/2 modem, the AJ 2412-3H1 should amply serve your needs.

FACT FILE

AJ 2412-3H1
Anderson Jacobson, CXR Telcom Corp., 521 Charcot Ave., San Jose, CA 95131; (408) 435-8520.
List Price: $449
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible.
In Short: A plain-vanilla modem at a midrange price, the AJ 2412-3H1 gives you every feature an average modem user needs.

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EVEREX INC.

Evercom 24/2

by Ross M. Greenberg

For $352, the Everex Evercom 24/2 is an MCA modem that offers everything you're likely to need, including an excellent manual. The modem is likely to work with any phone line, as our tests found its performance to be among the most consistent from line to line.

This modem's main strength is its manual. Containing information for both the novice user and the experienced communications programmer, and written clearly and concisely, it manages never to speak up or down to the reader.

The Evercom's support of communication protocols is on the slim side. Besides the Bell 212A and V.22 1,200-bits-per-second and the V.22 bis 2,400-bps protocols that all of these modems support, it works only with the Bell 103 protocol at 300 bps. Still, these are the protocols that are most popular.

One thing is certain—the people who designed this modem know what modem users want, because there are some interesting additions to the Evercom's functionality. For example, the modem has memory sufficient to store five phone numbers, more than any of its peers save Octocom Systems' OSI8224APS, which costs more than twice as much. And the speaker will turn on for about 5 seconds if the carrier is suddenly lost; this can immediately alert you to connection problems.

Additionally, the AT&P command (which allows you to set the make/break connection ratio on a pulse dial) has four

FACT FILE

Evercom 24/2
Everex Inc., 48431 Milmont Dr., Fremont, CA 94538; (415) 498-1111.
List Price: $352
Requires: IBM PS/2 Model 60, 70, or 80 or compatible.
In Short: Offering consistently good line performance, the Evercom 24/2 doesn't support a wide range of communications protocols, but its low price makes it a good buy.

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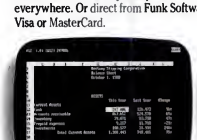

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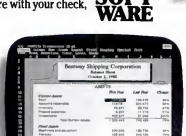

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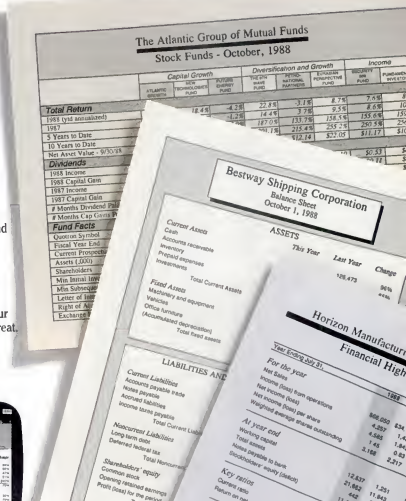

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different settings, including ones for the U.S. and the U.K., both with and without adaptive dialing. Adaptive dialing means the modem first tries tone dialing, then checks to see if there is still a dial tone, and then switches over to pulse dialing if the tone dialing didn't work.

However, this modem does have some limitations in its implementation of the AT command set. Specifically, it does not properly handle the ATC or AT&V commands. The ATC command, which turns the carrier on and off, is seldom used—it's not even included in the Hayes 2400 series modems—so we can live with that limitation. The AT&V command, used in many 2,400-bps modems to display the current settings, may be a more serious problem if this command becomes popular in the future.

But none of these AT command set limitations adversely affects the way the Evercom 24/2 works with some of the commonly used communications programs. (We tested it with *Crosstalk XVI*, *Smartcom II* and *Smartcom III*, *Relay Gold*, and *Lotus Express*.) The modem comes with a version of *BitCom*.

All in all, the Evercom 24/2 is an impressive modem and a good buy.

HAYES MICROCOMPUTER PRODUCTS INC.

Smartmodem 2400P

by M. David Stone

If you want to guarantee that your modem will work with any program designed for the Hayes Smartmodem, you can't do better than the real thing. Of course, there's a premium charged for the Hayes name—$549 to be exact. But it doesn't hurt that, in addition to being the originator of the AT command set, Hayes has a reputation for making better-than-average modems.

The Smartmodem 2400P is essentially identical in behavior to the current version of the 2400B; at least it showed no differences on any of our tests. As expected, the modem worked with all tested communications software without problems.

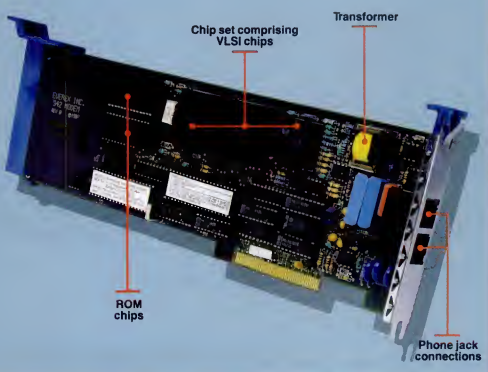
Later-generation Smartmodem 2400s include several features that are often missing even from close copies. For example, the ability to store two profiles (in addition to the factory settings) can be useful if you use two communication programs and need different settings for each. Similarly, the ability to view the modem settings is a welcome convenience. Less useful is the ability to store four phone numbers, since this duplicates features you should expect in your communication program.

The Smartmodem 2400P is identical in behavior to the current version of the 2400B; it showed no differences on any of our tests.

A nice touch is that you can buy the 2400P with or without software. Prices are $649 with Hayes' *Smartcom III* and $599 with *Smartcom II*. Be aware that *Smartcom II* is an adequate but clumsy program. If $50 is your budget for communication

AN MCA MODEM UP CLOSE

The communications functions of most of these MCA modems have been integrated into large-scale chips, resulting in an uncrowded board layout. Besides allowing room for future enhancements, such as chips that can handle facsimile functions, this integration has two benefits: it reduces the amount of power the board requires and the amount of heat it generates. The Everex Evercom 24/2 MCA modem board, shown here, is based on the Rockwell chip set, the most popular chip set among the modems reviewed in this article. This chip set constitutes the actual modem on the board; all other board components, such as the ROM chips and transformers, supplement it.



software, take a look at *ProComm* instead (or any of the other inexpensive programs that are widely available on bulletin boards). *Smartcom III*, on the other hand, has much to recommend it.

For basic communications, *Smartcom III* is easy to learn and use, yet it includes a script language sophisticated enough to build a bulletin board system. The program's only major drawback is its size; fully installed, it needs about 1.4MB of disk space.

Like most PS/2 modems, the Smartmodem 2400P handles asynchronous communications at 0 to 300 bps using the Bell 103 protocol, 1,200 bps using either Bell 212 or V.22, and 2,400 bps using V.22 bis. Unlike its peers, it lets you use V.22 bis at 2,400 bps for synchronous communications.

Synchronous communications with the Hayes AutoSync feature may be of interest if you need to communicate with a mainframe with a synchronous V.22 bis modem. Be aware, however, that to take advantage of AutoSync you need software that uses the Hayes Synchronous Interface and Hayes Synchronous Driver. According to Hayes, there are about 15 such packages currently available.

Overall, the Smartmodem 2400P offers no surprises—good or bad. As one more solid member of the Hayes clan, it's just what you would expect it to be: essentially indistinguishable from the Smartmodem 2400B, except that it fits into an MCA computer.

FACT FILE

Smartmodem 2400P
Hayes Microcomputer Products Inc., P.O. Box 105203, Atlanta, GA 30348; (404) 441-1617.
List Price: $549; with *Smartcom III*, $649; with *Smartcom II*, $599.
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible.
In Short: Expensive, like all Hayes modems, the Smartmodem 2400P stands out for its support of synchronous communications.

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INTEL CORP.

Intel 2400B Modem 2

by M. David Stone

If you like to buy from a company whose name is associated with quality but also like to save money, the Intel 2400B Modem 2 should grab your attention. Built around Version 1.5 of Intel's own modem chip set (no surprise there), the 2400B Modem 2 sells for $399—about $150 less than Hayes's Smartmodem 2400P—and is backed by Intel's usual 5-year warranty. That may be longer than you'll keep your current computer.

Like most PS/2 modems, the 2400B Modem 2 offers asynchronous communication only, using the Bell 103 protocol at 0 to 300 bps, the Bell 212 or V.22 protocol at 1,200 bps, and the V.22 bis protocol at 2,400 bps. In addition, it can communicate at 600 bps using the V.22 protocol.

The modem's command set is a close copy of the Hayes Smartmodem 2400's commands. Most of the differences are in commands that Hayes uses for synchronous communications. Since the Intel mo-

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dem doesn't have a sync mode, it answers those commands with a perfectly reasonable Error response.

The few other differences are with commands that you won't even find in any Hayes Smartmodem 2400s. For example, the &V command, for viewing current settings, gets an Error response. (But then again, it gets the same response from an early Hayes Smartmodem 2400.) None of these differences should have any effect on the modem's ability to work with communication programs.

The Intel manuals are excellent. You'll appreciate the step-by-step detail.

The Intel modem worked swimmingly with every program it was tested with, including *Smartcom II*, *Smartcom III*, *Crosstalk XVI*, *Lotus Express*, and *Relay Gold*. The odds are long against its having problems with other programs.

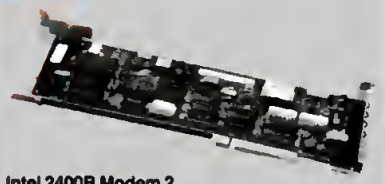
The Intel manuals are excellent. A "Modem Command Guide," subtitled "For Communications Experts," rightly points out that you can leave the issue of modem control to your communication program. For those who want to know the commands, however, it goes on to explain them. A nice touch is a command summary that not only serves as a quick reference but also gives page numbers for further information on each command.

A second manual gives installation instructions. If you've never installed a board in a PS/2 before, you'll appreciate the step-by-step detail. Intel also provides a useful troubleshooting tool in the form of its TESTCOM program. TESTCOM will run an automatic test on the modem and can call the Intel BBS to confirm that the modem is installed and working correctly.

As with most PS/2 modems, all configuration options are set from the keyboard, using either AT commands or the PS/2 reference disk. The only options in the Adapter Definition File are for comm ports one through seven. This is one less than with most other PS/2 modems, but seven ports seem more than enough for most purposes.

The one item missing from the reviewed package is a bundled communication program. According to an Intel spokesperson, software will have been added by the time you read this. Even

PC MAGAZINE FACT FILE



Intel 2400B Modem 2
Intel Corp., 5200 N.E. Elam Young Pkwy., Hillsboro, OR 97124-6497; (800) 538-3373
List Price: $399
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible.
In Short: Well priced and with a command set quite close to that of Hayes's Smartmodem 2400P and 2400B, the Intel 2400B Modem 2 includes great manuals and a 5-year warranty, making it an outstanding buy.

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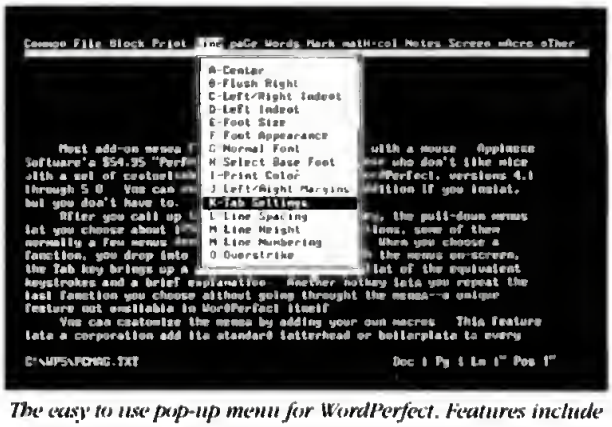

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CIRCLE 173 ON READER SERVICE CARD

without the software, though, the combination of price and Intel quality—backed by the 5-year warranty—makes this modem well worth a look.

MULTI-TECH SYSTEMS INC.

MT224PS
MT224ES

by M. David Stone

The Multi-Tech MT224ES, priced at $549, and the MT224PS, costing $499, are variations on a theme. They both have the same manual, the same basic design, and most of the same capabilities. The $50 difference is that the MT224ES adds MNP error correction and data compression. For this review, Multi-Tech Systems supplied both modems. All comments apply to both except where otherwise indicated.

The basic features are fairly typical. The modems provide asynchronous communciations using the Bell 103 protocol at 0 to 300 bps, Bell 212 or V.22 at 1,200 bps, and V.22 bis at 2,400 bps. All configuration options are set from the keyboard, using AT commands or the PS/2 reference disk and the modem's Adapter Definition File.

The two modems come with a modified version of *ProComm*, a program that is simple to learn yet able to handle most communication needs. Its features include a host mode, ten terminal emulations, and eight file transfer protocols. The modified *ProComm* (Version MT.2.4.3.) adds support for hardware flow control and for PS/2 comm ports 3 through 8. It also adds two file transfer protocols (Ymodem G and Ymodem G batch) that will speed file transfer when using MNP.

The command set for the modems is a superset of the original Hayes Smartmodem 1200 commands. A few additional commands are borrowed from the Smartmodem 2400. Others are specific to Multi-Tech. Alas, many of the Multi-Tech commands are the same as Smartmodem 2400 commands but do different things. The result can be confusing if you are already familiar with the Smartmodem 2400.

Confusing or not, the differences are unlikely to cause problems with software. For example, Hayes modems use L0 through L3 for volume control. The Multi-Tech units use L5 through L7 to list modem settings. If a program tries to set volume with the L command, the Multi-Tech modems won't do anything, but they will reply with an "OK" so that the software won't be confused by an error message. Also note that the Multi-Tech units are consistent with the Smartmodem 1200 command set. If you have a problem with a program installed for the Smartmodem 2400, you will probably be able to resolve it by reinstalling for the Smartmodem 1200.

Unfortunately, consistency with Hayes AT commands is not everything. In real-world tests, the Multi-Tech modems worked with *Crosstalk XVI*, *Smartcom II*, *Smartcom III*, and *Lotus Express* without problems. They also worked with *Relay Gold* with the program installed for "Other AT autodial modem." But they would not work with *Relay Gold* when installed for either the Smartmodem 1200 or 2400. This suggests timing differences that could affect the modems' ability to work with some programs.

These units have one somewhat annoying peculiarity. With most modems, if you tell the modem to go to answer mode, you can get the modem's attention and go back to command mode immediately by hitting any key. With the Multi-Tech modems, you have to wait the full time the modem is currently set for—usually about 30 seconds. This delay can quickly become frustrating if you accidentally go into answer mode.

Installing the Multi-Tech modems is simple enough, but if you're not already comfortable with installing boards in your PS/2, don't expect much help from the manual. It includes a sparse outline of the installation procedure, then refers you to your computer manual for further instructions.

If complete adherence to the Hayes 2400 command set is important—because you already have developed complex scripts based on that command set, for example—then the Multi-Tech units are the wrong modems to buy. However, if you are simply looking for a modem plus software, the MT224PS or MT224ES will serve your needs. If you want to take advantage of the growing popularity of MNP, consider the MT224ES.

FACT FILE

MT224PS
MT224ES
Multi-Tech Systems Inc., 2205 Woodale Dr., Mounds View, MN 55112; (612) 785-3500.
List Price: MT224PS, $499; MT224ES, $549.
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible.
In Short: Standard modems with high-end prices, these units are plagued by some AT command set difficulties. The MT224ES's support of MNP error correction makes it more interesting than its brother.

CIRCLE 612 ON READER SERVICE CARD

OCTOCOM SYSTEMS INC.

OSI8224APS

by Ross M. Greenberg

With a price and features that put it at the top of the line, the $845 OSI8224APS's chip-studded appearance makes it look far different from its peers. Ideal for oddball communication tasks, this modem from Octocom Systems may not communicate well with some other modems.

The OSI8224APS offers many features that its competitors lack. It is one of the few modems in this group to support MNP error correction. It offers enough on-board memory to store 20 phone numbers—four times what any of its peers offer—and eight different configurations in nonvolatile memory. It also comes with auto-logon and call-back capabilities, constant DTE interface speeds regardless of the modem-to-modem connection speed, fall-back and fall-forward rate detection, and a rather extended command set.

The Octocom modem has an extended command progress capability that gives additional information about the call. Although no communication programs currently utilize this information, it's very handy in interactive mode. Because its V.23 compliance (it sells primarily to a non-American market), the Octocom unit has the ability to "blacklist" certain numbers—to prohibit their being called—and to limit the auto-redial capability of the modem if necessary to adhere to various government regulations.

The Octocom unit is the only one of the tested modems with on-board DIP switches. These are used for setting the level of power used in transmitter output. The default, -9dBm, is sufficient for the majority

of connections but can easily be adjusted from -1dBm to -15dBm, a feature ideal for connecting with distant sites or sensitive modems. The installation process does not normally require you to fiddle with these switches.

The modem is also one of the two that come with an on-board speaker and volume control. Unfortunately the system is woefully inadequate, providing virtually inaudible sound even with the computer case off. This board does not come with a 16-bit extension, and its high price does not include a bundled communication package.

The OSI8224APS supports almost every standard you can think of: V.22 bis, V.22A/B, V.21, and V.23, as well as the more-usual Bell 212A, 202S, and 103 protocals. Surprisingly enough, this wide support caused the unit some problems.

During our testing, the ATA command (pick up the line in Answer Mode) operated peculiarly. When the command was entered, the normal abort technique of hitting any key operated for only the first 5 seconds of the answering sequence. After that, all keystrokes were ignored until the modem timed itself out, after about 30 seconds.

Consultation with Octocom revealed that the modem's answering sequence didn't properly account for all the different standards with which it works. The modem operated properly with all the communications packages we tested it with (*Crosstalk XVI*, *Smartcom II*, *Smartcom III*, *Relay Gold*, and *Lotus Express*), but this difficulty could cause some communi-

FACT FILE

OSI8224APS
Octocom Systems Inc., 255 Ballardvale St., Wilmington, MA 01887; (508) 658-6956.
List Price: $845
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible.
In Short: The most expensive of this group of modems, the OSI8224APS comes with many esoteric features. It has some AT command set problems but is ideal for a PS/2 owner with oddball communications needs.

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cation programs to have problems. Octocom says that it is working on a solution.

The Octocom unit's most serious problem, however, is its inability to connect to a Hayes V-Series 2400 in originate mode. An Octocom spokesperson was aware of the problem and said that it appears to be caused by the failure of the Hayes V-series 2400 modems to follow the CCITT standards properly. There was no problem, fortunately, in connecting with other modems tested.

The manual that was sent to us with the OSI8224APS was missing some important information. The modem offers a wide range of installation options, including the ability to set the comm port; the interrupt number, type, level, and priority; and the type of bus interaction that should be established (such as DMA or Burst). But the manual did not cover any of these options. A new manual is supposed to be available soon.

Octocom System's OSI8224APS is powerful and full-featured but not totally compatible with other modems. Some of the abilities it offers aren't found on any other PS/2 modem, and if you need these esoteric capabilities, the Octocom is the one to buy.

OMNITEL INC.

Encore 2400PS

by Ross M. Greenberg

A midrange internal modem in terms of price and features, OmniTel's $399 Encore 2400PS stands out because of its consistently high performance on our line tests. The modem is also one of the few to offer MNP error correction.

When you're communicating with another modem, you can control just about everything—except the condition of the telephone line. The Encore 2400PS' MNP option helps alleviate some of the problems of a poor-quality phone line. The difference in price for this standard option is only $100, and that's money well spent if you need to communicate across a noisy phone line.

The OmniTel modem handles MNP Classes 1 through 5. MNP Class 5 is interesting in that it allows for error-free transmission with little regard to the quality of the connection and can perform compression of the data stream on the fly. Depending on the type of data being transferred,

In Search of Hayes Compatibility

by M. David Stone

If you know nothing else about modems, you probably know enough to insist on Hayes compatibility. Unfortunately, as with IBM compatibility before it, Hayes compatibility is an elusive beast, and some products are more compatible than others. Since individual manufacturers are free to define the term however they like, the claim can be nearly meaningless.

Ideally, a Hayes-compatible modem should behave just like a Hayes Smartmodem so that you can take any communication program, install it for a Smartmodem, and not have to bother with it. More often the claim means that a modem behaves more or less like a Hayes modem, at least in the operations that a particular manufacturer deems important.

The most obvious differences in behavior come from using a subset of Hayes commands. In many cases, the differences are perfectly acceptable. For example, a modem that ignores the command to turn off the speaker can still communicate without problems—as long as it doesn't confuse a communications program by sending an error message when the communication program expects to see some type of approval code.

Potential problems crop up when a modem uses default settings or commands that conflict with those of the Hayes Smartmodem. For example, the Multi-Tech modem reviewed here has two sets of result codes. One matches the Smartmodem 2400, with the result code 6 meaning No Dialtone. But in the default set, 6 means exactly the opposite—that the modem has detected a dial tone. It's not hard to imagine a communication program or script that will interpret the 6 as a sign to hang up, and will, therefore, hang up whenever the Multi-Tech modem hears a dial tone.

More-subtle problems come from timing differences. A modem can follow the entire Hayes command set, issue the same responses as a Smartmodem, and still not work with a given program. If the program expects a response within a specific time bracket and the modem is a little faster or a little slower, the program may miss the response. Even when you're giving commands to a program manually, the difference in response time is sometimes noticeable.

Interestingly, even Hayes modems aren't entirely compatible with each other. For one thing, the command set varies from one Smartmodem model to another. That's why many communications programs have separate installation options for the Smartmodem 300, 1200, and 1200B on the one hand, and for the Smartmodem 2400 and 2400B on the other.

Ideally, a Hayes-compatible modem should behave just like a Hayes Smartmodem so that you can take any communication program, install it for a Smartmodem, and be done with it.

In some cases, the different models give responses that confuse software. At least one program (*Lotus Express*) won't work with the V-Series Smartmodem 9600 unless you modify the modem-initialization string. According to Hayes, the problem is that the program asks for the modem's ID, but has no way to deal with a response it doesn't recognize. As a practical matter, the solution of changing the modem-initialization string is easy enough. But clearly, in some sense, this

particular Hayes modem isn't entirely Hayes compatible.

Confusing the issue even further is that the Hayes command set varies even among the members of a given model of Hayes modems. In preparing this overview, PC Labs asked Hayes how many variations of each model existed and what the differences were. For reasons that are less than clear, Hayes considers this proprietary information, though a company spokesman was willing to answer questions about specific commands.

The existence of different-generation Smartmodems is obvious to anyone who types commands directly to the modems. For example, there are at least three generations of the Smartmodem 2400. The current version uses the &V command to list the modem settings. Early versions give an error response to &V. The current version stores two user-defined modem profiles. Early versions store only one. The current version stores four phone numbers, early versions store only one.

Going back at least one generation farther, the very earliest Smartmodem 2400 wouldn't respond to commands at 300 bits per second if the modem was in CCITT mode and wouldn't respond to 2,400 bps if the modem was set for Bell mode. In later versions, the setting for CCITT mode versus Bell mode chose between CCITT and Bell protocols only for 1,200 bps.

The most troublesome difference we found was in an inconsistent response to the ATZ command, which many programs rely on to reset the modem to a known state. On one Smartmodem 2400, if the modem is set for numeric response codes (with the ATV0 command), it will respond to an ATZ with the numeric code 0. On another Smartmodem 2400 (and on all Smartmodem 1200s tested), the modem responds with an OK.

As should be clear, there are enough differences among modems—even modems from Hayes—that the concept of Hayes compatibility is slippery at best. That's why you won't see the term in any of the reviews here. For most purposes, it's more useful to talk about the degree of similarity between e given modem and some particular Hayes Smartmodem model. It's also helpful to know how well the modem works with specific programs. Even better, when buying a modem, pick your software first (especially if you need some special-purpose software that can't be replaced) and ask the seller to guarantee that the modem you choose will work with the software you need. ■

SPEAKING THE HAYES LANGUAGE: THE AT COMMAND SET

These are some of the AT commands most frequently used by Hayes modems. You can communicate directly with your modem by issuing these commands through your communication software.

Command	Explanation
AT	Command prefix—precedes command line
A/	Reexecute previous command line; not preceded or followed by <CR>
ATB	CCITT V.22 mode
ATC	Assume data carrier always present
ATD	Dial—go into originate mode; dial number that follows; attempt to go to on-line state
ATDT	Tone dial—go into originate mode; dial number that follows; attempt to go to on-line state
ATDP	Pulse dial (factory setting)—go into originate mode; diel number that follows; attempt to go to on-line state
ATDR	Reverse mode—go into originate mode; dial number that follows; attempt to go to on-line state
ATE	Controls character echo
ATH	Controls modem hang-up
ATI	Request modem ID information
ATL	Controls speaker volume
ATM	Controls speaker response
ATO	Go to on-line state
ATQ	Result-code control
ATS	Modem S register control
ATV	Controls result-code display
ATX	Controls features represented by various result codes
ATY	Long space disconnect disabled
ATZ	Software reset—restores all default settings
AT&C	Controls modem based on DCD
AT&D	Controls modem based on DTR
AT&F	Recall factory settings as active configuration
AT&G	No guard tone
AT&J	RJ-aa/RJ-41S/RJ-45S telco jack
AT&P	Pulse dial make/break ratio = 39/61
AT&Q	Operate in asynchronous mode
AT&R	Track CTS according to RTS
AT&S	Assume presence of DSR signal
AT&T	Terminate presence of DSR signal
AT&V	View active configuration, user profiles, and stored numbers
AT&W	Save storable parameters of active configuration as user profile 1
AT&X	Modem provides transmit clock signal
AT&Y	Recall user profile 0 on power-up
AT&Z*n*=*x*	Store phone number *x* in location *n* (0–3)

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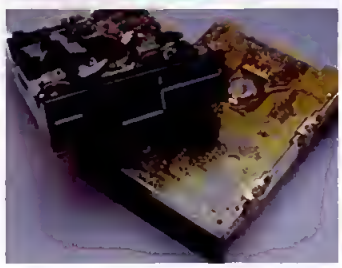

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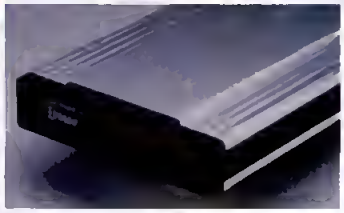

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CIRCLE 535 ON READER SERVICE CARD

2,400-BPS MCA MODEMS: SUMMARY OF FEATURES

	Anchor 2400PS Anchor Automation Inc. $279	PM2400 PS/2 Practical Peripherals $299	Evercom 24/2 Everex Inc. $352	Encore 2400PS OmniTel Inc. $399	Intel 2400B Modem 2 Intel Corp. $399
GENERAL FEATURES					
Chip set	Intel	Rockwell 5310	Rockwell	SSI	Intel, Version 1.5
16-bit extension on-board	●	○	●	○	●
Uses DIP switches	○	○	○	○	○
Speaker on-board	●	○	○	○	○
Volume control on-bosrd	●	○	○	○	○
Number of phone numbers stored on-board	1	4	5	4	1
Communication program included	*AnchorTalk*	*ProComm*	*BitCom*	*ProComm*	None
PROTOCOLS					
Bell 103 (0–300 bps)	○	●	○	●	●
Bell 103 (300 bps only)	●	●	●	●	○
600 bps	●	○	○	○	●
Bell 212A, V.22 (1,200 bps)	●	●	●	●	●
V.22 bis (2,400 bps)	●	●	●	●	●
SELF-TESTS					
Local Analog Loopback	●	○	●	●	●
Local Digital Loopback	●	○	●	●	●
Remote Analog Loopback	●	○	●	●	○
Remote Digital Loopback	●	○	●	●	●
Other	○	○	○	○	●
CONNECTORS					
One of two connectors goes dead during communication	○	○	○	○	●
INSTALLATION OPTIONS					
Communication port range	1-8	1-8	1-8	1-8	1-7
Addresses	Standard	●	Standard	Standard	○
IRQ	Standard	Com 2, IRQ	Standard	Standard	○
Arbitration level	○	○	○	○	○
AT COMMANDS					
Uses AT commands	●	●	●	●	●
Accepts both upper- and lowercase input	●	●	●	●	●
Accepts mixed upper- and lowercase input	●	●	●	●	○
AT command set is closest to that of Hayes Smartmodem model	2400B	2400PS	2400B	2400B	2400P or B
ERROR CORRRECTION					
MNP included (level)	○	○	○	○	○
MNP optional (level; price)	○	○	○	● (5; $100)	○
Other error-correction scheme available	○	○	○	○	○

Editor's Choice ●—Yes ○—No

Ven-Tel MCM-24 Ven-Tel Inc. $399	AJ 2412-3H1 Anderson Jacobson $449	MT224PS/ MT224ES Multi-Tech Systems Inc. $499/$549	Smartmodem 2400P Hayes Microcomputer Products Inc. $549	OSI8224APS Octocom Systems Inc. $845
Rockwell 83	Exar, Version 2.00	Rockwell G	Hayes	Proprietary
○	○	●	●	○
○	○	○	○	●
○	○	○	○	●
○	○	●	○	●
1	1	None	4	20
None	None	*ProComm 2.4.2*	None	None
●	●	●	●	●
●	○	●	○	●
○	○	○	○	●
●	●	●	●	●
●	●	●	●	●
●	●	●	●	●
●	○	○	○	○
●	●	●	●	●
○	○	○	●	○
○	●	○	●	●
1-8	1-8	1-4	1-8	1-4
○	○	○	○	Standard
○	○	○	○	Standard
○	○	○	○	●
●	●	●	●	●
●	●	●	●	●
●	●	●	○	●
2400P	2400B	01200	2400P	2400B
○	○	○ (MT224PS)	○	● (4)
● (5: $100)	○	● (3,4,5; MT224ES)	○	○
○	○	○	○	● (NARQ)

up to 50 percent compression can be expected. That translates into an effective baud rate of 4,800 bits per second—double the stated speed of the modem. However, it is rare that you'll see compression achieving such a rate. More commonly, you'll see 20 to 30 percent compression of text files and considerably less for files containing binary data.

Since MNP Class 5 modems can transmit data faster than their stated throughput, it is important that they contain flow-control capabilities for communications between the modem and the computer. With an extension to the more typical command set, the OmniTel allows for XON/XOFF. The 2400PS series, though, does not allow the CTS/RTS flow control found on its external cousins. However, the interface between the computer and the modem can be set for as high as 9,600 bits per second, virtually obviating the need for flow control, since the uncompressed file will not exceed that baud rate under normal circumstances.

Installing the modem was a simple task—drop it into the PS/2, plug in the phone line, and reconfigure the system. You're set to go. The Encore 2400PS comes bundled with *ProComm;* testing showed it to work with the standard communication programs that we tried with all of these modems.

Our tests pointed up two minor problems with the OmniTel modem. Both concerned the use of the PS/2's internal speaker. In our volume-control tests, we found virtually no level change when testing with the standard volume-control commands. Further investigation showed that the Om-

FACT FILE
EDITOR'S CHOICE

Encore 2400PS
OmniTel Inc., 3500 W. Warren Ave., Fremont, CA 94538; (415) 490-2202.
List Price: $399; with MNP, $499.
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible.
In Short: Able to perform consistently well under a wide variety of bad line conditions, the Encore 2400PS offers a $100 MNP option that makes it an even better deal.

CIRCLE 614 ON READER SERVICE CARD

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- Parallel & Serial Ports
- Clock Calendar
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- 5 Drive Bays
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- Security Lock
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CGA Color	Add:$170
EGA Color	Add:$400
VGA Multiscan	Add:$670

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CIRCLE 352 ON READER SERVICE CARD

HOW WE TESTED 2,400-BPS INTERNAL MCA MODEMS

Every time a modem connects to a telephone line, it's engaging in a crapshoot. There are more than a dozen different kinds of line impairments that can show up on a phone network. Any of these—or any combination of them—may be present in a given call. And those that are present can have varying degrees of severity from one call to the next.

This yields a virtually unlimited set of possible line conditions, depending on such variables as whether the call is local or long distance, whether it is sent through satellites or terrestrial circuits, and whether any of the phone lines involved are too close to a power line in Nebraska—or swinging in a stiff breeze in Colorado. The wider the range of line conditions that a modem can handle acceptably, the less likely it is to have problems with a given call.

To determine how these PS/2 modems perform, PC Labs devised an automated test using a combination of equipment from Telecom Analysis Systems, an Eatontown, New Jersey, company specializing in "telephone impairments generation." The TAS 1010 Voiceband Channel Simulator was used to control line conditions, and the TAS 1020 Modem Test Unit (MTU) was used to measure modem performance. Both units were controlled through the *Taskit* software package.

The tests examined modem performance under seven different line conditions. Six of these are from a proposed standard of the Electronics Industries Association, and the seventh represents an average case line. These tests are described in greater detail in the descriptive caption accompanying the performance tests.

The EIA test lines took 7 years to develop, and they are noteworthy for providing the first U.S. standard for testing modems. Be aware that these are not pass-fail tests. In fact, the proposed standard makes a point of stating that "it is left up to the modem suppliers and users to determine what level of modem performance constitutes passing or failing."

According to the proposed EIA standard, the six EIA lines "are not intended to portray impairment combinations that might be encountered on an average dialed connection, but rather provide a set of particularly stressful conditions more representative of marginal connections." Taken together, and especially along with the average-case line, they cover a wide range of possible conditions.

During the testing process, half of the modems we originally set out to review were withdrawn from the tests by their manufacturers. Some were taken back because the automated testing revealed that they had clearly unacceptable performance in one or more of the test conditions. In these cases, the manufacturer confirmed the problem and withdrew the modem for further development.

In all tests, data was sent between two units of the modem being tested. This simultaneously tested the transmitter on one modem and the receiver on the other. It also eliminated the need for choosing an arbitrary reference modem to judge all other modems against. Such reference modems sometimes work better with modems from the same manufacturer than with units from other manufacturers.

The modems were tested at both 1,200 and 2,400 bits per second. The results for the 1,200-bps tests are not shown because there were no significant differences among the modems at that speed.

As the results show, modems may be designed to work on some kinds of bad lines but not on others. In fact, it is actually possible to build a modem that will work on bad lines but not on good ones.

Be aware that modem error rates are statistical in nature. In fact, modem performance is often given as a curve that shows modem error rates over a range of signal-to-noise levels. In theory, there is no such thing as a zero error rate for a modem. Rather, there are smaller percentages of errors as line conditions improve. On "zero-error-level" tests such as those shown here, the results are subject to statistical variation—meaning that a given modem can produce different results at different times under the same line conditions.

To prove the point, we tested one modem 84 times on all seven line conditions in receive originate mode. As expected, graphing the results for each line condition produced a bell curve. In six of the seven test lines, more than 90 percent of the results came within 1 dB of the peak. The EIA 1 test gave a flatter bell curve, with 80 percent of the results falling within 2 dB of the peak.

The statistical nature of the results means that you can't draw a meaningful distinction between modems on the basis of a 1- or 2-dB difference in the test results (even if this difference recurs under several test conditions).

Don't be misled into thinking that performance differences are never an issue with modems. The survivors have relatively similar overall performance partly because the poorest performers have disappeared from the comparison, and partly because the small number of PS/2 modems currently available just happen to provide similar performance under most conditions.

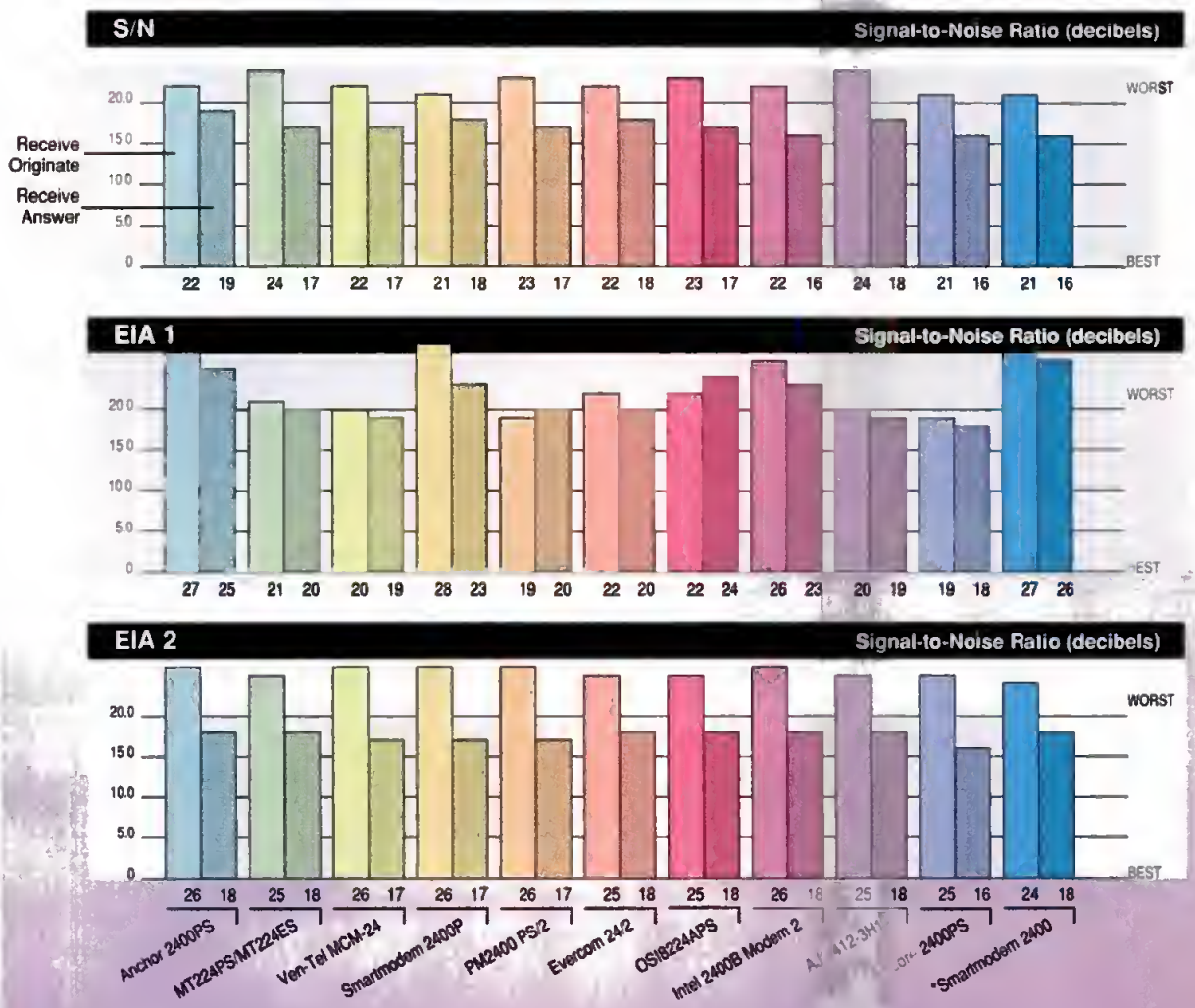
Survival of the Fittest

The Electronics Industries Association test line specifications took seven years to develop, and are noteworthy for providing the first U.S. standard for testing modems.

PERFORMANCE TESTS: 2,400-BPS INTERNAL MCA MODEMS

The PC Labs modem tests measure a modem's ability to operate reliably with various signal-to-noise ratios on seven line conditions. Six of these are the recommended test conditions in the proposed EIA-496-A standard of the Electronics Industries Association. The seventh is an average-case line, which sets all line impairments to their 50 percent levels, as determined in the 1982–83 survey of the predivestiture Bell Telephone network. The EIA-proposed lines are designated as EIA 1 through EIA 6. The average-case line is designated S/N. Results are given as the signal-to-noise ratio, in decibels, required for reliable operation.

For each line condition, the test starts with a high noise level (yielding a low signal-to-noise ratio) and sends 100 blocks of data consisting of 100 bytes each. The modem being tested compares the received data with the data sent. If there are any errors, the connection is dropped, the noise level on the line is lowered (yielding a higher signal-to-noise ratio), the connection is reestablished, and the 100 blocks are sent again. This is repeated until the 100 blocks can be sent without error.



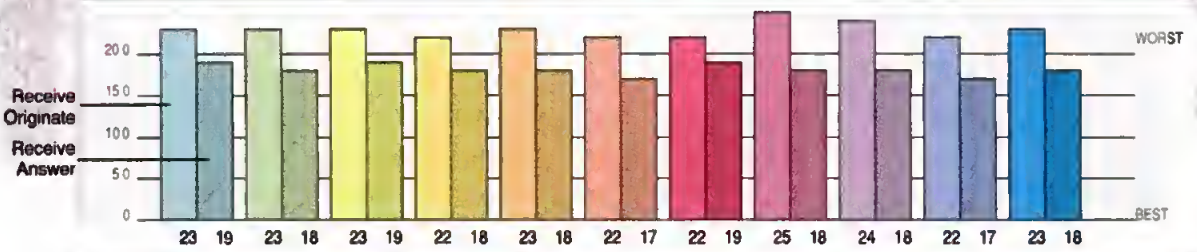
* This product was not reviewed, but we are reporting its test results for comparison.

CONTINUES

PERFORMANCE TESTS: 2,400-BPS INTERNAL MCA MODEMS

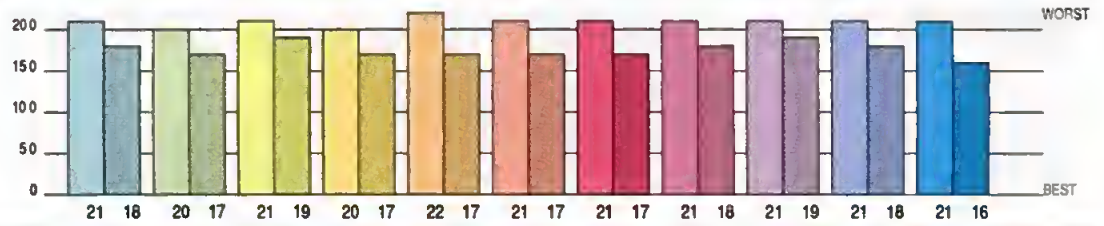
EIA 3

Signal-to-Noise Ratio (decibels)



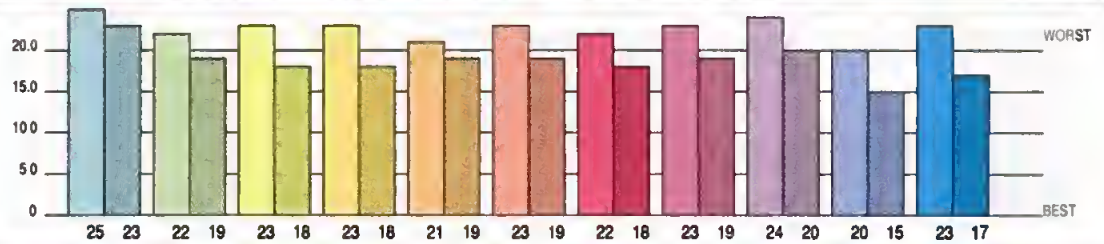
EIA 4

Signal-to-Noise Ratio (decibels)



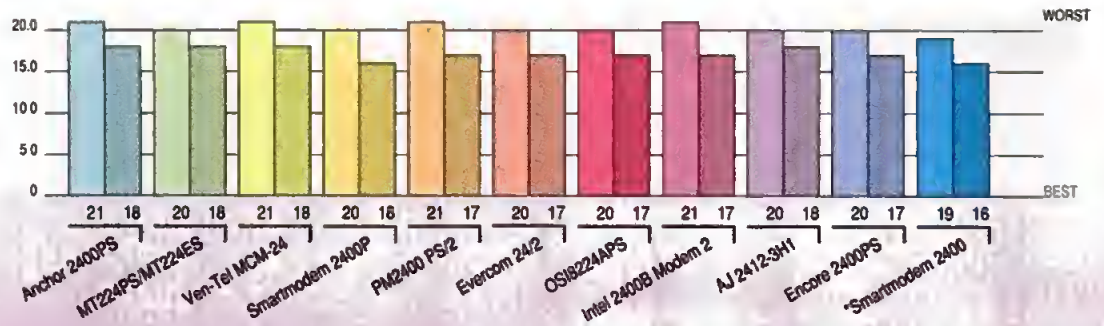
EIA 5

Signal-to-Noise Ratio (decibels)



EIA 6

Signal-to-Noise Ratio (decibels)



* This product was not reviewed, but we are reporting its test results for comparison.

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PC MAGAZINE

EDITOR'S CHOICE
IQ Engineering Super Cartridge 2
June 13, 1989

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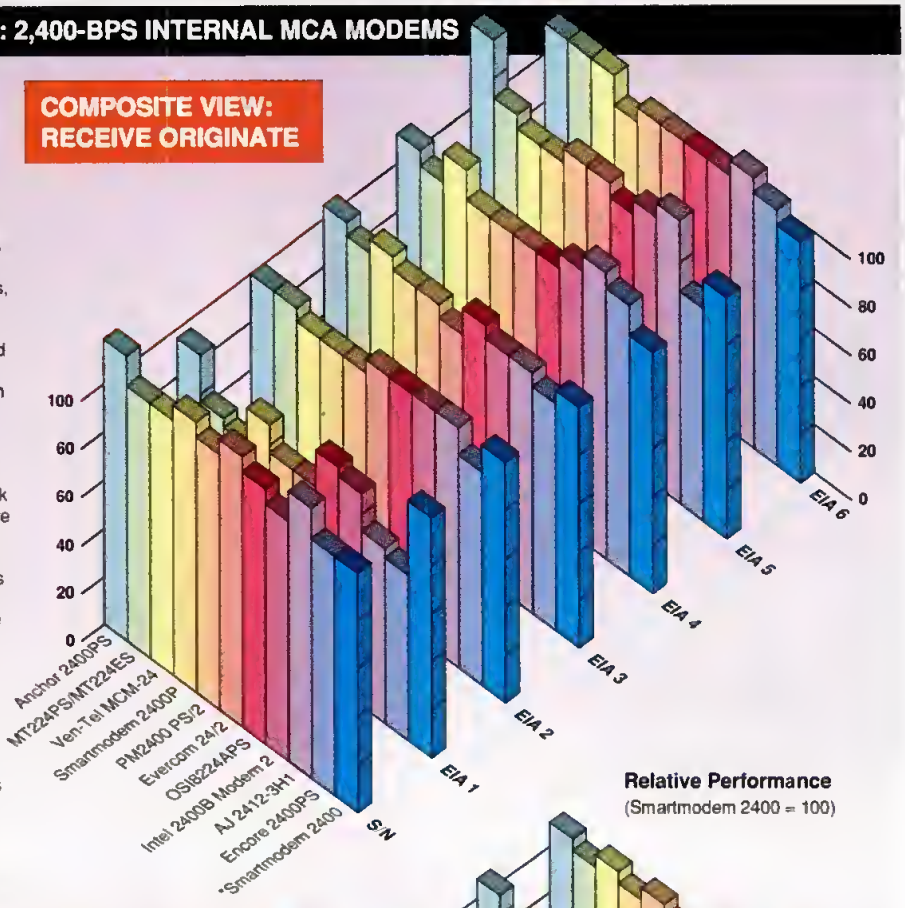
CIRCLE 325 ON READER SERVICE CARD

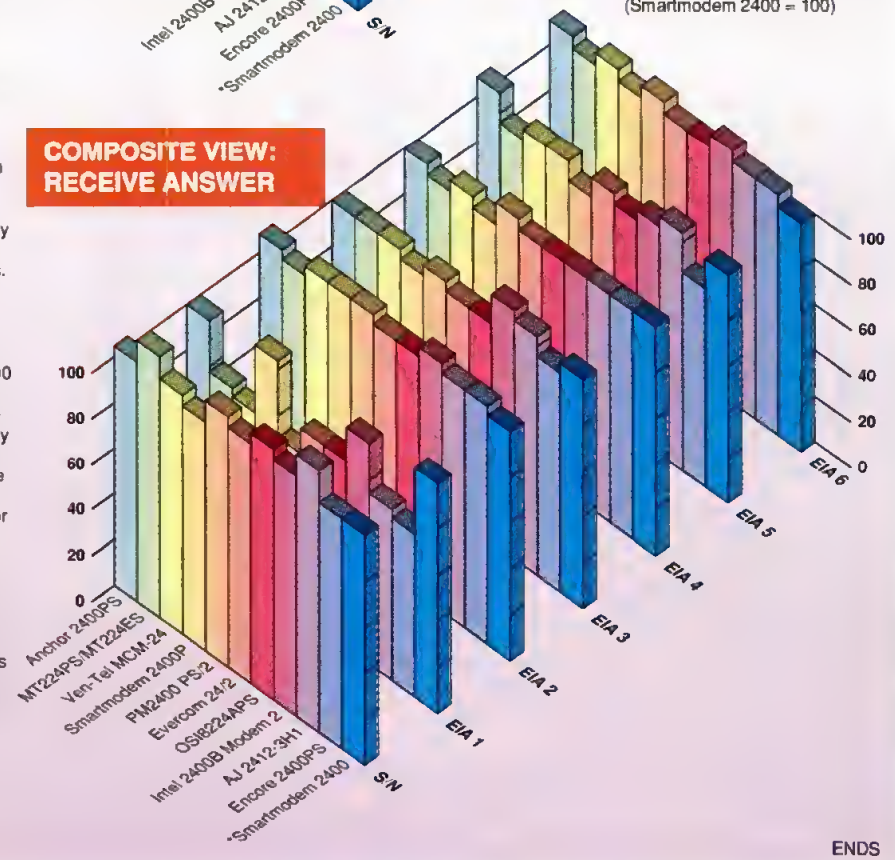
PERFORMANCE TESTS: 2,400-BPS INTERNAL MCA MODEMS

COMPOSITE VIEW: RECEIVE ORIGINATE



Relative Performance
(Smartmodem 2400 = 100)

COMPOSITE VIEW: RECEIVE ANSWER



The results of PC Labs' 2,400-bit-per-second modem performance tests show differences ranging from an insignificant 1 dB in receive originate mode on EIA 6 to a substantial 9 dB in receive originate on EIA 1. Results are shown as the signal-to-noise ratio, in decibels, required for each modem to transmit the test data without error. Lower numbers mean that the modem succeeded with a noisier line, and thus indicate better performance.

No modem gave the best performance on all 14 lines. OmniTel's Encore 2400PS came close, leading the pack in ten cases and coming up just 1 dB shy of the top in four. At the other extreme, Anchor Automation's Anchor 2400PS was at the bottom of the pack on eight test lines and never managed a score that was better than midrange.

Comparisons among the other modems are a little trickier. Most of the tested modems balanced their overall performance by doing better than average on some lines and worse than average on others.

Modems that consistently performed in the middle of the pack or better, such as Everex's Evercom 24/2 or Practical Peripherals' PM2400 PS/2, are somewhat preferable to a modem like the Smartmodem 2400P from Hayes Microcomputer Products, which performed slightly better on some lines and notably worse on others. As you might expect from the similarity of design among Hayes's Smartmodem 2400 models, the results for the 2400P are similar to those for the external Smartmodem 2400, whose test results are shown here for comparison. Both are solidly in the middle of the pack.

The MT224 modems from Multi-Tech Systems did better than the Evercom 24/2 on four lines and worse on four others, but all of the differences are within ±1 dB and could easily be the result of statistical fluctuation. By contrast, the consistency of the OmniTel's good performance inspires faith in the results.

In judging each modem, it is important to look at overall performance instead of concentrating too much on the test lines where differences were greatest. For example, Hayes's external Smartmodem 2400 turned in some of the worst results for EIA 1, yet the modem works acceptably on the real-world telephone network. The point is that any one test line represents conditions that show up in only a small percentage of actual phone calls. A modem that has problems with a particular test may still function adequetely for most calls.

The relatively small spread in overall performance, with results bunched fairly closely on most of the test lines, means that performance should be a secondary consideration in choosing among these modems. You can safely narrow your choices by looking at features first and then choosing the best-performing modem with the features you want.

* This product was not reviewed, but we are reporting its test results for comparison.

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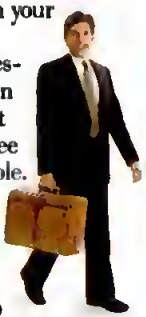

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niTel modem has extended the range of the speaker-control commands, so our tests were only scratching the surface. It is doubtful that many communication programs will know about this extension, so this added feature might cause a problem, albeit a small one, for some packages.

Additionally, the ATM3 command, which silences the speaker during actual dialing but turns it on briefly when the connection is made, did not function properly. Neither of these idiosyncracies should cause problems with any communications functions of the modem, though they may affect what you hear when you dial a call.

The Encore 2400PS performed well, and its MNP capabilities make it a champ when working under poor phone-line conditions.

Practical Peripherals

PM2400 PS/2

by Ross M. Greenberg

With midrange features and a low-end price, the $299 PM2400 PS/2 performed very well in our AT command testing.

Most of the other modems we tested exhibited problems with the AT command set that could create problems with communications software. The PM2400 PS/2 had no such trouble. Though it failed to include the ATF command (this command allows the modem to echo characters locally) in its repertoire, this command is so esoteric, and is used so rarely, that it shouldn't be missed.

The PM2400 PS/2 also fails to include the &T set of commands. These commands test, either through analog means or digitally, the operability of the modem locally or in combination with a remote modem. You'll miss this command only if the remote modem attempts to initiate such a test. We don't consider the lack of this command set to be of any real importance, and it should not get in the way of your normal use of this modem.

Built around the Rockwell 5310 chip set, the PM2400 PS/2 doesn't offer a 16-bit extension.

As do the majority of its peers, it supports the Bell 103 0 to 300-bps and 300-bps-only protocols, as well as the Bell 212A and V.22 1,200-bps and V.22 bis 2,400-bps protocols. The modem doesn't offer self-tests, but it is set apart by its ability to monitor the progress of calls.

Installation of the PM2400 presented no problems; you simply plug and play and you're set to go. The documentation was adequate and indexed. Practical Peripherals has included *ProComm* with the modems, a wise decision on the company's part. The shareware *ProComm* program is widely used and considered a good bargain, and considering the price of the modem, the inclusion of superb software like *ProComm* is a pleasant surprise.

Our testing showed the PM2400 to

FACT FILE

PM2400 PS/2
Practical Peripherals, 31245 La Baya Dr., Westlake Village, CA 91362; (818) 706-0333.
List Price: $299
Requires: IBM PS/2 Model 50, 60, 70, or 80 or compatible
In Short: With a good price and average features, the PM2400 PS/2 is distinguished by its lack of AT command set difficulties.

CIRCLE 615 ON READER SERVICE CARD

What Should You Buy, Internal or External?

by Bill Howard

When you bought your first CP/M PC, an external 300-bit-per-second Hayes Smartmodem was a smart bet. The same modem could be hooked to Apples, IBMs, assorted Osbornes and Morrows, and even dumb terminals. The status lights told you how your communication session was faring. You could reach around back and adjust the volume by turning a knob. It didn't steal a slot from the computer. The brushed aluminum case looked neat sitting on the desk—yet another piece of hardware attesting to your appreciation of things technical (neater still if you tossed in another $200 for Hayes' matching chronograph—basically a $200 clock). It's pretty clear the PC is here to stay, so buying an internal modem dedicated to one computer bus isn't the act of faith in IBM it once was.

I've heard from several info center managers who prefer external modems because they don't have to fieldstrip their PCs when internal modems fail. But who's ever had a modem fail? Over time, most users come to realize that modems work just fine, and if the modem doesn't get through now because of line noise, it will 5 minutes from now.

The evidence is mounting in favor of internal modems: They're cheaper, your desk isn't cluttered by the modem, and it doesn't exacerbate your spaghetti tangle of wires (to which an external modem adds two: power and signal). You don't have to find two free spaces on your power strip for the power transformer (which uses one outlet and typically blocks a second). You don't have to buy a serial cable. Hayes has never tried to bundle its (formerly execrable) *Smartcom* software with external modems, only with the internals. And internal modems are less likely to be stolen—or do you work in a company where *nothing* is ever pilfered?

Now your info center has to stock and order two kinds of internal modem—classic bus and PS/2—and some die-hard external-modem fans would bemoan the complexity of switching modems around, should the company change buses with the next order of PCs. But in truth, once an add-in card goes into your PC—whether it's for memory, video, LAN, or communications—it stays there for the life of the machine.

So it all comes down to this: Do you need to watch the blinking red lights or not? I'd rather see the lights, but not enough to put up with the clutter and cost. Internal modems reflect the state of communications today—reliable enough that you can tuck the electronics away and know the job will get done.

What should you buy? As Bill Murray said in the summer-camp movie *Meatballs*, "It just doesn't matter." ■

Bill Howard is an executive editor of PC Magazine.

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Andrew Seybold's Outlook on Professional Computing

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Microtimes, Nov., 1988

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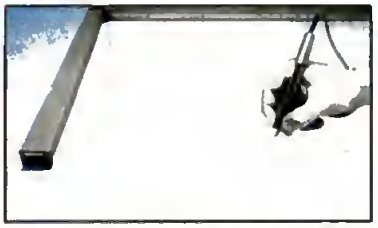

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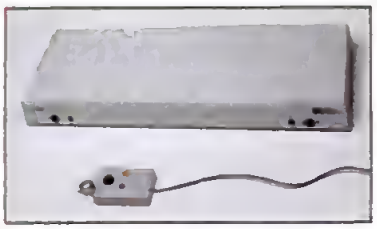

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VEN-TEL INC.

Ven-Tel MCM-24

by Ross M. Greenberg

Also known as the Internal Modem 24/2, the Ven-Tel MCM-24 is a midrange-priced modem with average features. Only its support of MNP error correction sets it apart from most of the pack.

The MCM-24 performed well on our AT command tests. Some of this unit's commands operate differently than those of modems such as the Hayes 2400; for example, the ATO1 command, which allows you to "retrain" the two connected modems, is implemented differently because of one of the MCM-24's special testing modes—but the end result is the same.

The manual for the Ven-Tel modem is good. It goes to considerable length in explaining how to set up parameters with some comm packages. This information was helpful in getting the modem to work properly with such notoriously finicky programs as *Smartcom II* and *Crosstalk XVI* (which can be purchased with the MCM-24 for an additional $100), and even with programs such as *ProComm* and *PC-Talk4*. Newcomers to modem communication will appreciate the step-by-step instructions provided for setting up the modem and configuring it to work with these communication programs. The Ven-Tel MCM-24 worked well with all the communication programs with which we tested it.

Like three of its peers, the Ven-Tel modem allows for only one user profile to be stored, via the AT&W command in its on-board memory. Although most communication programs allow you to store this information in software, this lack could conceivably create some compatibility problems, since it doesn't match what Hayes offers.

If you were thinking of using the Ven-Tel modem for leased phone lines, forget it. The MCM-24 doesn't support them.

The Ven-Tel MCM-24 lacks the ability to control the volume on the PS/2's speaker. While most modems control the speaker through software using the ATL set of commands, the Ven-Tel doesn't, so you're stuck with a speaker volume somewhere between low and medium.

If your modem needs are ordinary, the Ven-Tel should work well, but you could do better for the money. ■

FACT FILE

Ven-Tel MCM-24
Ven-Tel Inc., 2121 Zanker Rd., San Jose, CA 95131; (408) 436-7400, (800) 538-5121.
List Price: $399; with *Crosstalk XVI*, $499; MCM-24E, $499; MCM-24E with *Crosstalk XVI*, $599.
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EDITOR'S CHOICE

• **Encore 2400PS**

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Ross M. Greenberg is a frequent contributor to PC Magazine *and an online addict, using modems for about 50 percent of his waking day. He also writes communication programs. M. David Stone is a contributing editor of* PC Magazine, *with a special interest in communications.*

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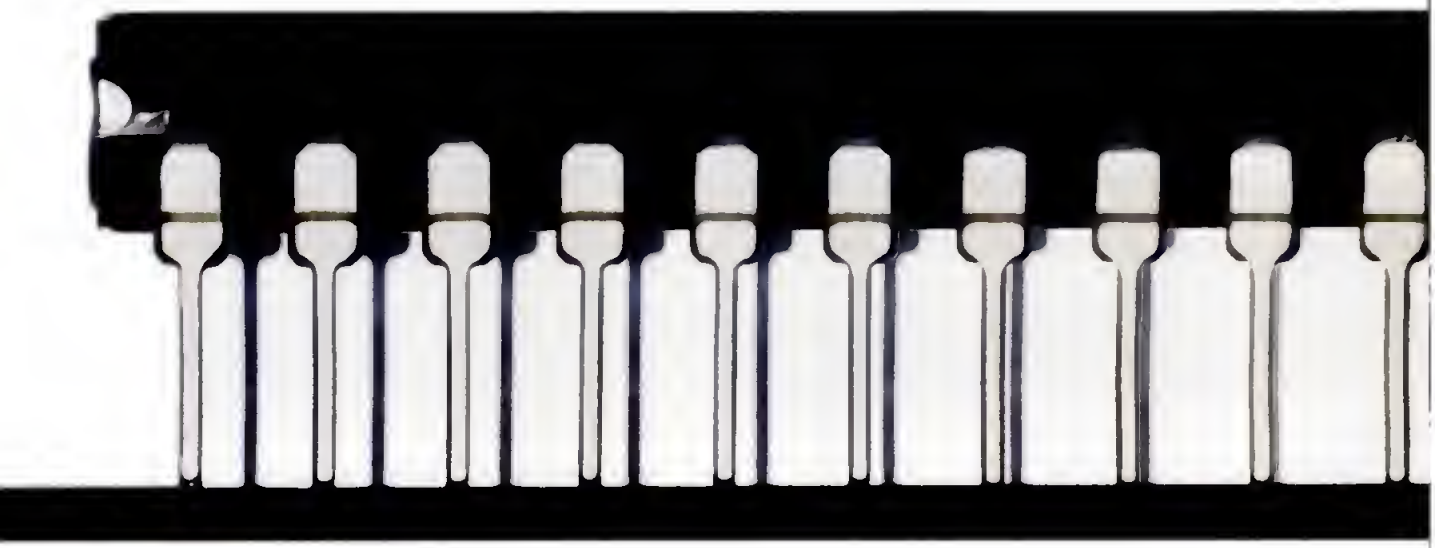

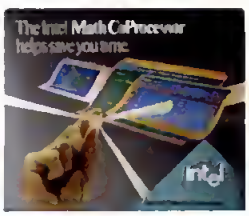

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Data Switches

A Low-Cost LAN Alternative

by Frank J. Derfler, Jr.

PHOTOGRAPH: STEPHEN HELLERSTEIN

Inexpensive and versatile, data switches serve as LAN alternatives that require nothing more than a serial interface.

As reliable and easy to use as a telephone, the data switch is a data- and peripheral-sharing facilitator that seems primitive when compared with even low-cost LANs. Nonetheless, data switches are increasingly being recognized as an efficient way to make flexible connections.

In our review of low-cost LANs in the March 28, 1989, issue of *PC Magazine*, we briefly described data switches. They are external boxes that work like telephone hubs; through them, PCs make connections with each other and with external devices such as modems and printers over standard serial links. Although data switches might seem low-tech in comparison with full-scale media-sharing LANs like Novell's *NetWare*, the fact that a growing number of companies sell them shows that data switches are beginning to be taken seriously as a simple and effective way to interconnect small groups of PCs and printers.

Media-sharing LANs, as the name implies, simultaneously carry messages, in the form of packets or tokens, from multiple stations over a high-speed cable. Because the cable system moves data 5 to 15 times faster than a PC can accept it, network designers have enough headroom to create elegant operating systems that fool DOS into thinking distant disk drives and printers are really on the local computer. This lets DOS applications use the network, but the special interface cards and sophisticated software these systems require also make them costly and challenging to install and maintain.

A STUDY IN SIMPLICITY

By contrast, data switches are attractively cheap and simple. They cost a little more than $100 per workstation, compared with about $350 per station for the low-cost LANs in our earlier review and about twice that for a full-featured media-sharing LAN. While data switches are most suitable for small networks (most handle from 8 to 24 connections), with the proper software you can chain them together to form networks of hundreds or even thousands of nodes. And because they use standard serial connections, you can integrate a wide variety of different types of computers into a single network, from PCs, laptops, and Macintoshes to minicomputers and mainframes.

The trade-off is in speed and power. Most data switches are limited to a speed of 19,200 bits per second, well below the 10 megabits per second supported by Ethernet, and they require a dedicated cable to each workstation. Moreover, they cannot manage simultaneous accesses to the same data file, so you can't run complex multiuser databases on PCs linked through a data switch. But for the basic tasks of printer sharing and exchanging files, the capabilities of a data switch are quite adequate.

In fact, if you have a minicomputer, you can even get around these limitations by running your accounting, inventory, and other multiuser systems on the large system, using the data switch to give your PCs access to it as terminals. This architecture offers good performance at a cost comparable to a multiuser LAN system, but without the latter's complexity. And as a bonus, you'll get the full security and data management features of the minicomputer operating system.

UNDER THE HOOD

From the outside, a data switch is just a box, ranging from the size of a clothbound novel to that of an AT-compatible PC. Inside, you'll find a number of ports—usually between 8 and 24, though the Commix 32 from Infotron Systems Corp. can take up to 32 ports and the INC-64 Intelligent Network Controller from Western Telematic can handle as many as 64. A dedicated microprocessor handles the port control and switching tasks, giving the switch enough processing power to handle the traffic of all the ports at once. You connect the switch to the workstations and other devices using dedicated serial cables. You do not need to install a special interface card in your workstations, as most PCs today come equipped with at least one serial port.

A data switch is equally straightforward in its operation. When it's running, the switch constantly listens for commands from the workstations. When a workstation signals the switch for a connection to another port, the switch makes the link and then leaves it alone until the workstation receives a signal to disconnect. This lets the workstations use modems or printers as if they were local devices.

If you make a link between workstations, the two machines can exchange files over the wire using the appropriate communications software. And if the other port is connected to a minicomputer, the workstation can load terminal-emulation software and sign on to the remote system. In all cases, the data switch is transparent once it's connected.

Data switches are cheap and simple. And because they use standard serial connections, you can integrate a variety of computers into a single network.

VARIATIONS ON A THEME

The data switches on the market offer several elaborations on this basic scenario. For print buffering, most of the switches we reviewed come with a substantial amount of RAM installed—often as much as 4MB. A number of them support parallel ports, allowing easy connection to parallel printers, and handle the serial-to-parallel conversions automatically. Others, such as the Alternet from Equinox Systems, let you use parallel printers attached to remote workstations. If the switch does not support parallel ports, you can connect your parallel printers through an external serial-to-parallel converter.

Many switches can run their serial links faster than 19,200 bps, the maximum speed allowed within the RS-232C specification, but this extra speed makes the cable more susceptible to electrical interference. Some even support RS-422 serial connections, which can run reliably over longer distances than the RS-232 links and allow speeds of up to 38,400 bps. In either case, most can translate between serial devices running at different baud rates, letting you use high-speed links to your workstations without having to downshift when connecting to slower serial printers and modems.

If your switch supports parallel ports, you can often configure it for input from a workstation as well as for output from a printer. This makes for a very high-speed link, though you're limited by the 15-foot length of the average parallel printer cable. But since the parallel ports on data switches and most PCs are not bidirectional, this arrangement is not practical for two-way data exchange.

INSTALLATION AIDS

If you've ever installed a modem or a serial printer, you know that the so-called "simple" and "standard" RS-232 interface is, in fact, neither of these. Since designers of equipment and software can implement the RS-232 wiring scheme in many different ways, variations in the configurations of the wires that send and receive data and the presence or absence of various status signals often conspire to make successful communications very difficult. For this reason, the physical wiring of the network is usually the hardest part of installing a data switch. The ability of the 1082 MainStreet from Newbridge Networks to sense the configuration of the cable and adapt to it is a significant help.

Fortunately, the cabling itself is not much of a problem with these serial networks. Often, you can use twisted-pair telephone wiring already in the walls to connect your workstations with the switch, provided that the wire doesn't run more than a few hundred feet. If you can't use the wiring in your walls, almost all of the data switches in our review let you use telephone-type wiring with small RJ-11 or RJ-45 telephone-type connectors.

If your installation requires all eight wires for full hardware handshaking, you can use unobtrusive serial cables that are easy to install under carpet, through a false ceiling, or around wallboard. Small con-

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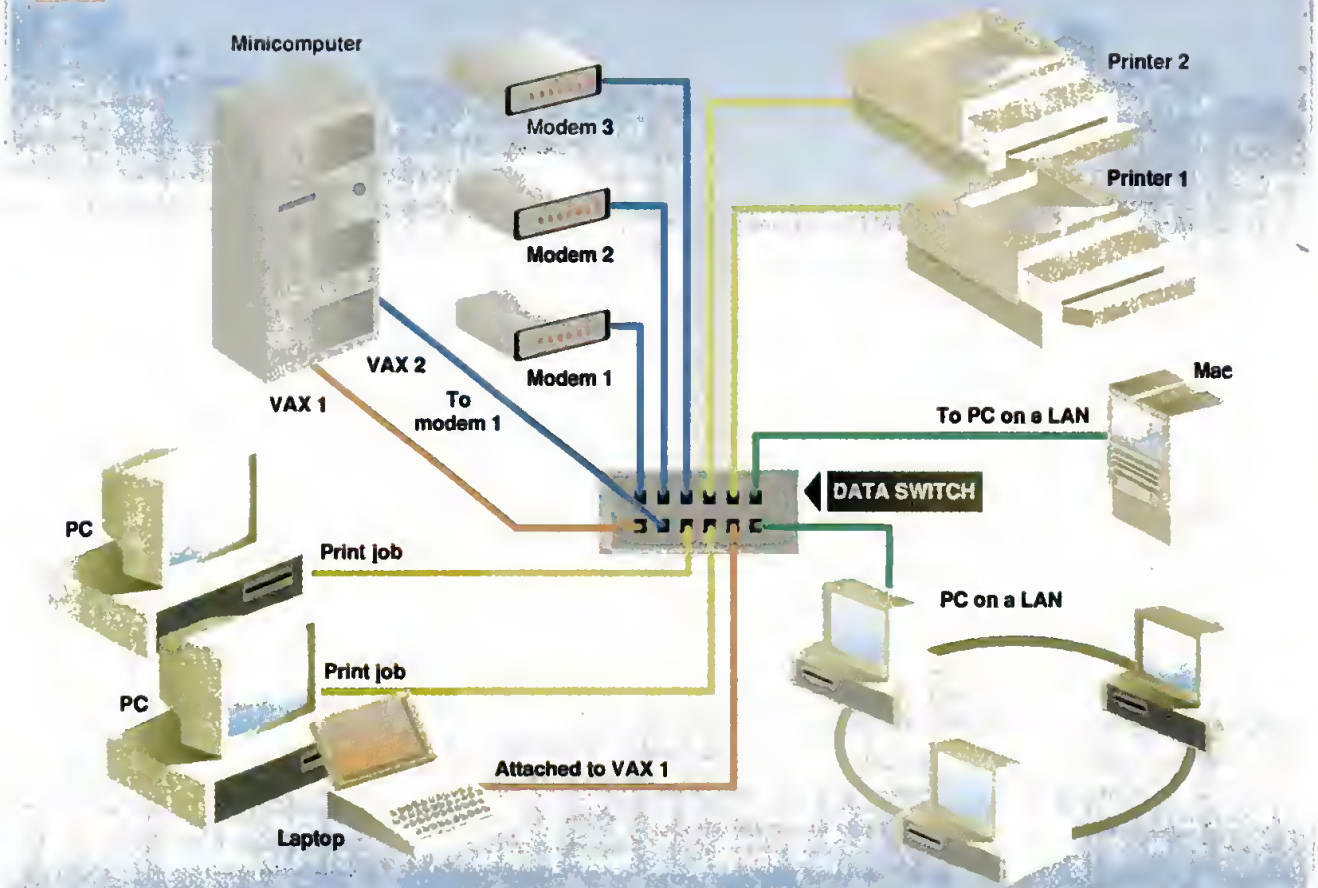
DATA SWITCH TOPOLOGY



Data switches give users the ability to inexpensively link dissimilar computers, allowing them to share resources. At a typical cost of slightly over $100 per connection, a good data switch can connect PCs, Macintoshes, laptops, and minicomputers running compatible communications software. The linked computers can transfer files, transmit e-mail, and share devices like printers and modems by using serial and parallel ports on a first-come-first-served basis.

In this diagram, the data switch is programmed so that a Macintosh remotely controls a PC on a LAN, a laptop runs a DBMS program on a DEC VAX, another VAX port connects to a modem, and two PCs dump print jobs to the print queue buffer in the switch. A hunt group would allow any of the computers to make use of whichever of the three modems happened to be available. All of these activities are controlled with simple menu programs.

verter boxes are available to link the DB-25 or DB-9 connectors on your PCs to modular telephone plugs.

Once the switch has been wired in, you use the configuration program supplied by the switch vendor to set it up. The program tells the switch which devices are attached to which ports and sets the speed and other communications parameters for each one. Once configured, the information is held in battery-backed RAM, so it will be safe for a time even if you should turn the switch off.

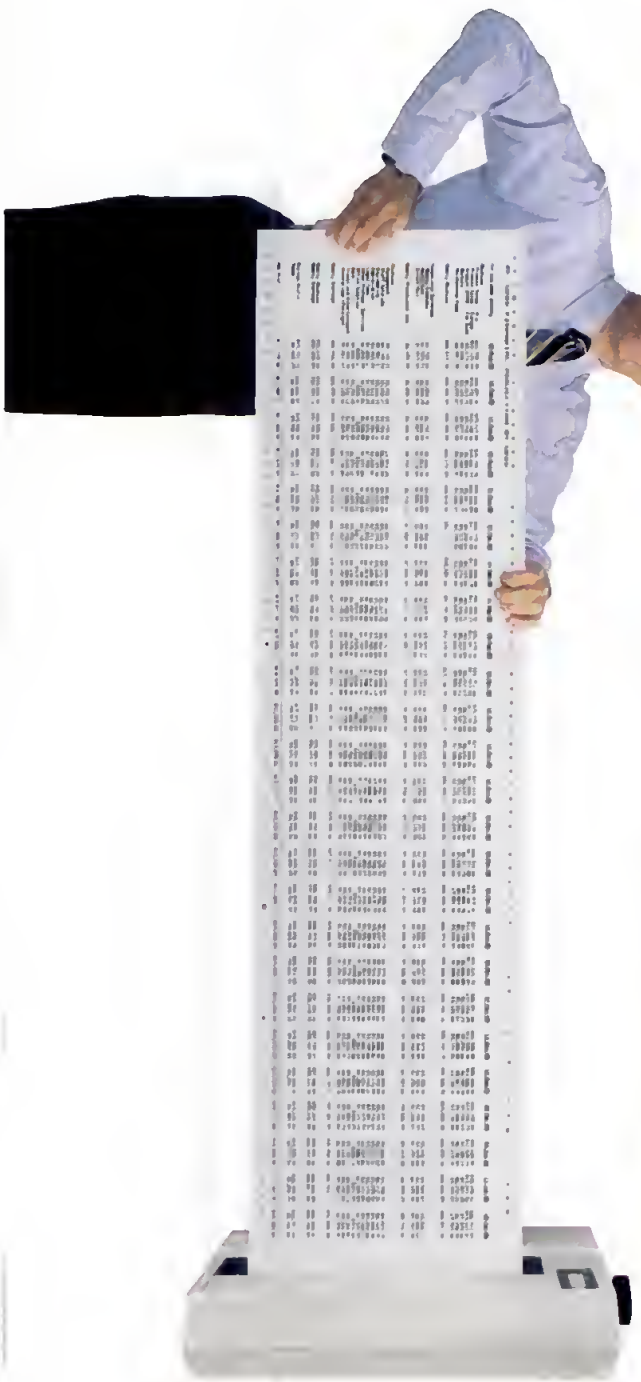
If the data switch has a security system, you'll also set this up. Though data switch systems are often run without passwords, almost all the switches we reviewed can be programmed to ask for an entry password, and some can password-protect specific resources such as modems connected to long-distance lines.

For even easier use, you can often set up "hunt groups" that let users select the first available port among several ports attached to identical devices. For example, you might connect 4 ports of a 32-port switch to 9,600-bps V.32 modems. When a user requested a V.32 modem, the switch would then find the first open V.32 port. Hunt groups are also an excellent way to control contention for a few expensive minicomputer ports.

CONTROL SOFTWARE

Once you've set up the switch, you can control it through software. Most switches come with memory-resident utilities that let users make port connections and control their print jobs through menus. In many cases, these programs can read the configuration information from the switch so that users can connect to printers or other workstations without having to know the port number or the other technical details of the connection. But if you prefer to set up batch files to control the connections, all of the switches will respond to commands sent to the ports or embedded in print jobs.

Funk Software continues to forge Sideways.



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New Sideways version 3.2 works with all releases of 1-2-3 as well as other software. Add-in capability requires 1-2-3 release 2 or Symphony.

Funk Software, 222 Third Street, Cambridge, MA 02142

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CIRCLE 323 ON READER SERVICE CARD

Once the connection has been made, printing is a simple matter. Nearly all programs that drive printers have parallel and serial port options, and your software won't care if the printer is in the next room or the next building. Most data switches dynamically allocate the memory in their print buffers as needed, and some offer software that spools jobs to a user's own hard disk or to the hard disk on a remote workstation.

MOVING FILES

Some of the switches we reviewed come with software that lets you transfer files from workstation to workstation in background mode. This is a desirable feature because it allows you to send files without disturbing the recipient. Sometimes, you even get e-mail and terminal-emulation software thrown into the bargain.

But these functions don't require special programs. You can always make your connections through the switch using the menu program or batch files, then load a communications program or a high-speed file transfer program such as *Lap-Link* or *The Brooklyn Bridge* to do this work. Similarly, you may prefer a full-fledged third-party electronic mail system to the rather limited versions that come with the data switches.

Most switches come with control software: memory-resident utilities that let users make port connections and control their print jobs through menus.

The most sophisticated switches, such as the NetCommander NC16 from Digital Products and the Master Switch (N Series) from Rose Electronics, offer true networking software as an option. These programs support virtual drives just like media-sharing network operating systems, making file transfers much simpler. You simply assign a drive letter to the remote workstation disk, then use the DOS COPY command to transfer the file over.

Though they'll never replace the true media-sharing LANs, data switches are hard to beat for many connectivity duties. Their low prices and their versatility make them attractive alternatives to large installations; for a small office, a data switch may be all you need. The advanced features of today's models go a long way toward disarming the often-frustrating problems of serial connections.

Frank J. Derfler, Jr. is workgroup systems editor of PC LAN Labs.

APPLIED CREATIVE TECHNOLOGY INC.

Systemizer Plus

by Randol Tigrett

Applied Creative Technology offers a data switch with a different twist. In its Systemizer Plus system, each PC or serial device has a separate local control unit, with all of the units connecting to form a kind of distributed data switch. In theory, this design is more reliable than a centralized switch because there is no single point of failure. But the Systemizer Plus's flexibility comes at a price—$399 per port, a steep sum when compared with centralized data switches, which can cost as little as a quarter of that.

Each Systemizer Plus unit looks much like the cable adapter box on top of your television set, with 14 pressure-sensitive keys on the front of the case and lights that you can use to monitor network activity. You can configure the input and output ports (all of which have female DB-25 connectors) as either parallel or serial. Each unit comes with 64K of RAM for buffering print jobs and saving e-mail messages; you can increase the RAM to 1MB. The memory expansion board comes with no RAM but uses standard 256-kilobit or 1-megabit chips. The chips are available from the vendor. Applied Creative Technology also offers a 1-year factory warranty and provides free technical support to end users, though it doesn't have a toll-free line.

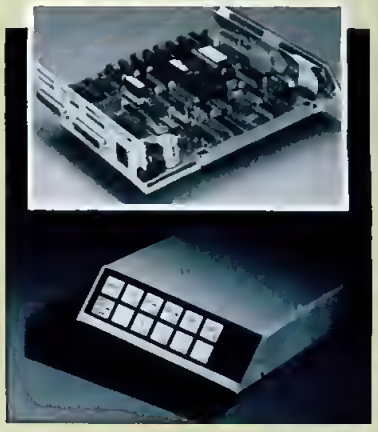
The system uses a simple and flexible wiring scheme. Each unit has an RJ-11 modular telephone jack, and you use ordinary T-connectors to form a kind of network backbone, daisy chaining the switches from device to device. You can attach a total of 31 devices, provided that no two of the devices are more than 1,200 feet apart.

The network normally runs at a maximum speed of 19,200 bits per second. However, a "double-speed" function offered through an optional program called *ACTFast* allows it to communicate at up to 38,400 bps. At this rate, the Systemizer Plus turned in a respectable performance, but you can only use the *ACTFast* program if the network cables are less than 350 feet long.

FRONT PANEL CONFIGURATION

You don't use software to configure these switches. You assign a unique node ID to each box by setting a DIP switch, and you set the serial input/output parameters as well as the size of the e-mail buffer by using the keys on the front panel.

A useful configuration option is the ability to program a port to connect to another port when powered up. Thus, for example, if several people share a single laser printer, you could set up their Systemizer boxes to connect to that port automatically, avoiding any need to select that printer manually or to program a batch file to do it. You can set up hunt groups in the switches, as well as programming the switches to translate character strings into commands, a powerful feature for controlling printers and other devices that may not be supported directly by your software.



Applied Creative Technology's Systemizer Plus system requires each PC and serial device to have a separate local control unit. At $399 each, the units make the switch cost much more per port than its peers.

PHOTOGRAPHS: THOM O'CONNOR

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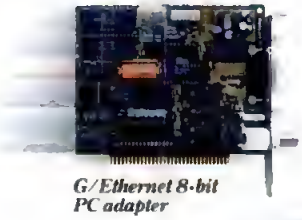
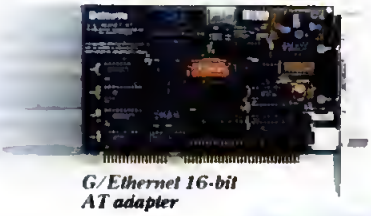
If you think all ETHERNETS are created equal...

think again...



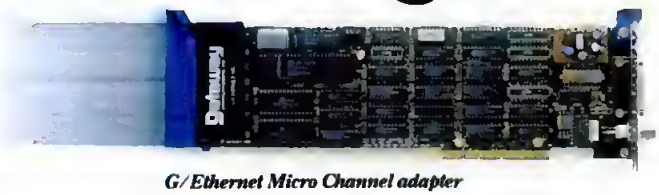
G/Ethernet 8-bit PC adapter

and again...



G/Ethernet 16-bit AT adapter

and again.



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AVATAR CORP.

Alliance

by M. Keith Thompson

In its features, the eight-port Alliance from Avatar Corp. is a solid, middle-of-the-road data switch with room to expand. But in performance, the $1,195 switch is something else—its custom gate array lets it communicate at a blazing 115,200 bits per second over serial cables up to 500 feet long, making it one of the fastest networks we tested.

The Alliance switch does have its limitations. It doesn't show the connections between the ports on the front panel—the box has only two lights, Ready and Power. And it does not let you install parallel ports; if you want to attach a parallel printer to the network, you must purchase a separate parallel-to-serial converter. Finally, unlike most data switches, the Alliance does not have a print buffer.

Instead, jobs are spooled to the disk on the workstation originating the print job. The print spooler is quite limited, however. You can print spooled files automatically in the background, and the spool software lets you clear the print buffer, pause and resume printing, and change printers. But you can't cancel or reprioritize individual print jobs.

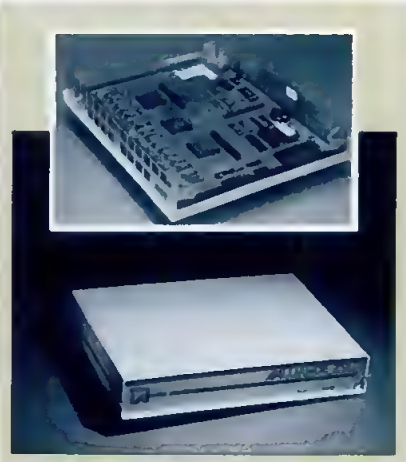
Moreover, though you can use up to 54K of your workstation's RAM as a print buffer, the software does not support expanded memory, and you may not be able to afford the luxury of dedicating that much conventional memory to this mundane task. Besides, 54K is not nearly enough if you frequently print large jobs such as graphics images. You can get around this problem by attaching an external print buffer, but at extra cost.

EXPANDABLE TO 20 PORTS

The switch itself is well made. The base unit comes with eight serial ports, which can be expanded to up to 20 ports by adding two-port serial expansion cards. As it comes in the box, you get four 20-foot cables with the Alliance—two designed to attach printers to the switch, one with a DB-9 connector for attaching an AT-compatible PC, and one designed for attaching a modem. Thus, you can easily get started configuring a small network right away. For a larger network, you would use eight-wire telephone cable with RJ-45 modular jacks.

The Alliance comes with a 1-year factory warranty that you can extend at extra cost. The company offers unlimited free technical support at a toll-free number.

The Alliance's security and log-in features enable each user to select his or her own password for starting the network. In addition, you can assign a separate password to each of up to 20 protected directories on your hard disk. The system also lets you set up hunt groups (Avatar calls this process "generic pooling") so that users can connect to the first available device in a group of printers, modems, or gateways. A transaction log helps you to keep track of the network activity on each computer.



The Alliance from Avatar Corp. is one of the three data switches in this review able to communicate at 115,200 bits per second. The $1,195, eight-port switch lacks parallel ports and does not have a print buffer.

BIG FOOTPRINT

Alliance comes with menu-driven software for controlling its functions. Its full kit of e-mail, file transfer, and print control features takes up a whopping 128K of RAM, and you can't change the hotkey (Alt-Space) if it conflicts with other programs. The software is modular, however, and if you can do without some functions, you can cut down on the RAM usage considerably (the basic peripheral-sharing functions take up only 8K of RAM). And you can connect and disconnect to ports on the Alliance through batch file statements, making it easy to use with existing software.

The Alliance handles file transfers smoothly. You can exchange files with any other station on the network, either im-

SPEEDY FILE TRANSFERS

The SysPlus software that comes standard with the Systemizer Plus includes both e-mail and file transfer functions. ACTMail uses a *WordStar*-like text editor to create messages that can be sent to any PC on the network. The messages are straightforward ASCII text files with a date and time stamp—you cannot attach binary files to them.

ACTLink, the file transfer program, looks much like *Lap-Link* or *The Brooklyn Bridge* but includes a security scheme that allows password protection down to the file level.

But the Systemizer Plus may be of the greatest interest to those with plotters, laser printers, or other devices that use the HPGL (Hewlett-Packard Graphics Language) standard. Unlike many switches, which expect printers only to receive information, the Systemizer Plus supports HPGL's ability to send messages back to the workstation with such information as the size of the paper that is loaded. Since *AutoCAD* and other packages that use plotters often depend on this feature, it may be a must for your installation, as plot jobs from multiple network stations may not spool up properly without it. To make use of this bidirectional communication features, however, your plotter or laser printer must be attached to a serial port.

If you've been hunting for a data switch that can do this for you, the high cost of the Systemizer Plus probably won't matter. And it certainly is a speedy, reliable networking alternative. But if cost is an overriding consideration, you can do better elsewhere.

FACT FILE

Systemizer Plus
Applied Creative Technology Inc., 8333 Douglas Ave., #700, Dallas, TX 75225; (800) 433-5373
List Price: Systemizer Plus with SysPlus software, $399; Memory expansion board (0K RAM), $59; *ACTFast*, $69.95
Requires: PC with DOS 2.0 or later to run utility software.
In Short: A unique distributed system, the Systemizer Plus offers high technology at a high price. File transfers are fast and efficient, and the diagnostics are excellent. The bidirectional HPGL support will be of special interest to users working with CAD/CAM installations and other such plotters.

CIRCLE 428 ON READER SERVICE CARD

FACT FILE

Alliance
Avatar Corp., 65 South St., Hopkinton, MA 01748; (508) 435-3000
List Price: Eight-port switch, $1,195; 14-port switch, $1,595; 20-port switch, $1,995. (All come with four 20-foot cables and software for all nodes.) Six-port expansion module; $600.
Requires: PC with 512K RAM, DOS 2.0 or later.
In Short: A reputable data switch offering the expected features, the Alliance excels in high-speed data transmission and the distance it allows between devices.

CIRCLE 429 ON READER SERVICE CARD

mediately or by queuing them for later transmission. The files are received at the destination workstation in the background so that you won't interrupt what the recipient is doing. Avatar does not offer true store-and-forward electronic mail, but you can post messages on a bulletin board for all users to read or send a "rude" message to all the current users. And you can use any third-party package that supports RS-232 communications.

Overall, the Alliance is a reputable data switch that offers many options. It is weak on printer sharing, but it speedy background file transfers and excellent security features may be just the ticket if you're mostly interested in swapping files.

BAY TECHNICAL ASSOCIATES INC.

BayTech Model 24

by Mike Byrd

With a mix-and-match design especially good for those with heterogeneous setups, Bay Technical Associates' BayTech Model 24 data exchange system excels at printer sharing. But its relatively sluggish performance and its lack of crucial features like passwords and hunt groups make it much less suitable for file transfer and modem sharing duties.

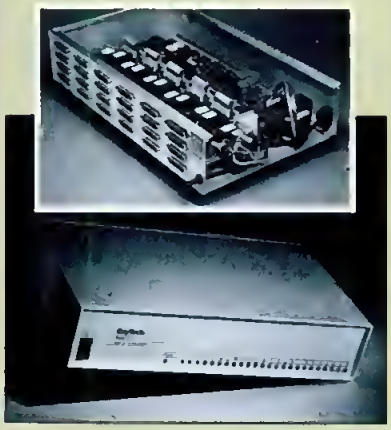
The $695 BayTech 24 comes in a polished aluminum box with 24 port activity lights sharing the front panel with the power switch and light. Inside the box, a Z8001 microprocessor driven at 9.83 MHz handles the switching chores. The base unit comes without any ports, but its 6 expansion slots—each of which can take a 4-port serial or parallel board—let you install up to the maximum of 24.

The parallel ports (which you can purchase either on a four-port card or in combination with two RS-232 serial ports) can be configured for either input or output. All serial ports come with male DB-25 connectors, which you can convert for use with RJ-11 or RJ-45 modular telephone jacks.

BEYOND RS-232

Unlike most of its competition, the BayTech unit supports RS-422 and current-loop serial ports, as well as the more common RS-232 ports, at speeds of up to 38,400 bits per second. This support gives you unparalleled flexibility in integrating standalone devices such as data collectors, lab instruments, and scales into your network, as well as mainframe and minicomputer links. The system will automatically adjust for different baud rates and converts serial to parallel and vice versa as necessary.

Whatever mix you choose, the BayTech Model 24 will do its job almost without your noticing it. Its large print buffer (512K of RAM standard, expandable to 4.5MB through its four memory expansion slots) lets several users share the same printer with ease—the data switch itself takes care of spooling and printing the multiple jobs in the order received.



The BayTech Model 24 system is sluggish for file transfer and modem sharing duties. For $695, the base switch comes without any ports, but each of 6 expansion slots can take a 4-port serial or parallel board.

If you have multiple printers, users can contend for them on a first-come first-served basis or can select a specific printer by sending the appropriate port selection code. However, once you've sent the job to the buffer, your control over it is limited: you can cancel your last job, but you can't manage the print queue or reprioritize or hold jobs.

The switch comes with a 1-year manufacturer's warranty, and Bay Technical Associates offers technical support at a toll-free number.

FACT FILE

BayTech Model 24
Bay Technical Associates Inc., P.O. Box 387, 200 N. Second St., Bay St. Louis, MS 39520; (800) 523-2702 (outside Miss.), (601) 467-8231.
List Price: Base unit with 512K RAM and no ports, $695; four-port I/O modules, $200 each; 256K memory upgrade, $144; 1MB memory upgrade, $459.
Requires: Any PC with standard serial or parallel ports
In Short: A rugged, no-nonsense data transfer box that excels at printer sharing but falls short as the center of a network.

CIRCLE 542 ON READER SERVICE CARD

OUT OF THE BOX

Installing and configuring the BayTech 24 is a snap. We had two computers sending data to a printer in less than 5 minutes. You run the menu-driven system-configuration program from a PC attached to the unit's master configuration port. The configuration program lets you determine the serial parameters and other setup information for all the other ports in the unit. It also lets you define which ports can and cannot be connected to each other. Since the system does not support log-on or device passwords, this is the only way that you can restrict access to given devices. The system does not support hunt groups.

Once the unit is set up, you can use a memory-resident menu program (which takes up 15K of RAM) to connect to any port by popping it up from within your application. The switch does not come with any print spooling, file transfer, or e-mail software, but you can use third-party packages for these functions.

The BayTech 24 suffers from a few glitches that were common to most of the data boxes in this comparison. If the printer is off, data sent to it is lost with no warning (the owner's manual cautions you about this problem). Also, the subscripts and superscripts (as done by *WordStar*) were printed as a full roll of the line rather than the normal half-line.

The BayTech Model 24 is a solid ma-

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T&R Textiles INC.

MEMO TO: M. Scott
FROM: H. Green
SUBJECT: Status Report

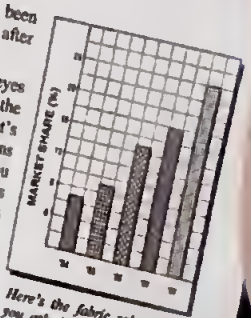
Mike, here's a quick update on how things have been going in your absence. I'll make it mercifully brief; after all, your vacation isn't officially over 'til Monday.

First, feast your eyes on this layout for the fall issue of FA. That's one of our new designs on the cover, as if you didn't know. Looks like our PR efforts really paid off.

More good news: our new DisplayWrite 5/2 Composer is up and running, and as you can see from this memo, calling it just a word processor is probably the understatement of the year. I think it's going to be a terrific productivity/communications tool around here.

Okay, so much for the software review. Back to business. As you probably know, it's getting to be commitment time on Project Moonrise. One of us is going to have to have a meeting with McCarthy to get the final details hammered out. The week of the 17th is about the latest we can let it go and still give ourselves enough time to complete the order. What I'd like to suggest is that you and I go as a team; that way I'll be in a position to step in and handle things if it turns out you have to go back out to the Coast. I know it looks unlikely at this point, but I think you'd ultimately feel more comfortable if we were both up to speed

(!)



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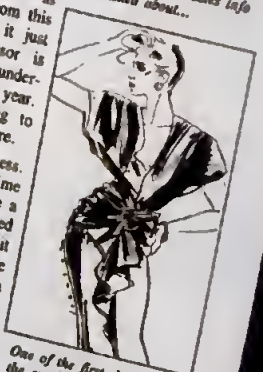

One of the first sketches for the evening-wear project.

A Brand New Resolution
The Handy Scanner
HS-3000

Desktop publishing has never been easier! With the new Handy Scanner® 3000, you can easily add graphics to your documents. Additional software is also available for rapid text entry.

The Handy Scanner 3000 is the first hand-held scanner to offer four (100–400 dpi) resolutions for the IBM PC/XT/AT, PS/2 Models 25/30, 50/60, and their compatibles. You can scan images 4⅛" wide and up to 20" long. The scanner has unique features such as 32 levels of grey resolution for crisp clear images, a fast 7-sec. speed for 10" scans at 300 dpi, and a yellow-green light that captures the reddish skin tones of your images (scanners with red lights just can't see the all-important skin tones). What's more, a real-time screen lets you instantly see your scanned images, so you can quickly make adjustments if needed.

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CIRCLE 742 ON READER SERVICE CARD

chine for printer sharing, with easy installation and straightforward operation that ensure it will need little attention once you've set it up. But its very simplicity is also a drawback: it doesn't have the necessary features to shine as a network hub.

BUFFALO PRODUCTS

Buffalo SL

by Mike Byrd

It probably wouldn't be at home on the range, but the Buffalo SL peripheral-sharing device might find a home in your office. With its simple, standardized layout and user-friendly control software, the $500 ten-port switch is a good choice for small installations.

The Buffalo SL comes in a sturdy, enameled box, with a power light and ten port-status LEDs decorating the front panel. A 10-MHz NEC V20 microprocessor gives it enough power to handle simultaneous transmission over all ten of its channels. The base product comes without memory, but four memory expansion slots let you install up to 4MB of RAM for print buffering. The unit comes with a 1-year warranty, and Buffalo offers unlimited free technical support, although not at a toll-free number.

FACT FILE

Buffalo SL
Buffalo Products, 2805 19th St. SE, Salem, OR 97302; (800) 345-2356, (503) 585-3414
List Price: SL-00 (0K RAM), $500; SL-256 (256K RAM), $600; SL-512 (512K RAM), $700; SL-1000 (1MB RAM), $900; SL-2000 (2MB RAM), $1,300; SL-3000 (3MB RAM), $1,700; SL-4000 (4MB RAM), $2,100; 256K memory upgrade, $100; 1MB memory upgrade, $400.
Requires: PC with DOS 2.0 or later.
In Short: A flexible, intelligent data transfer box suitable for small networks. Good software and documentation

CIRCLE 543 ON READER SERVICE CARD

The unit comes equipped with six RS-232 serial ports (which run at speeds of up to 19,200 bits per second) and four parallel ports that can be configured for either input or output. All of the ports come with female DB-25 connectors for use with standard Centronics parallel or four-wire null-modem cables. If you'd rather use telephone-type wiring, Buffalo Products sells modules ($15 a set) that convert the DB-25 jacks to RJ-45 modular telephone jacks. The system automatically matches serial parameters to allow connections between devices running at different baud rates. Multiple data switches can be cascaded together to form networks of practically unlimited size.

As with most data switches, the hardest part about installing the Buffalo SL is getting the correct cables. Configuring a workstation to run on the network takes about 5 minutes—you run a configuration program and answer a series of questions for which most of the default responses are adequate. Reconfiguration is equally straightforward: you simply run the program again.

The $500 Buffalo SL peripheral sharing device from Buffalo Products comes with six RS-232 serial ports (which run at speeds of up to 19,200 bits per second) and four parallel ports.

You can configure all of the ports on the switch from a PC attached to port 5. You can set these parameters from other workstations, as well, but only if the optional security password is not set; if it is, you can change only your own settings.

EVERY WHICH WAY

The Buffalo SL's memory-resident control program, which can support a mouse, offers a novel twist. If you're using a graphics application, you can pop up the control program over your graphics display without blanking the display or interfering with it, provided you can give up 25K of your precious RAM. In text mode, the program takes up only 15K, and if you can't afford even that much, you can run it in nonresident mode. If you prefer to control the switch through batch files, you can do so by typing ASCII command strings to the switch or by embedding them in output files or print jobs.

A most useful feature for network supervisors is the program's macro mode, which lets you build custom menus for each user. These menus allow you to do a wide variety of things, such as setting up hunt groups, selecting and configuring ports on the data switch, and even issuing printer commands to change fonts or sheet feeder bins. Since each user will only see his or her assigned options, you can protect devices from unauthorized use. The system does not come with file transfer or e-mail software, so you'll have to use third-party programs for these functions.

The Buffalo SL peripheral sharing device is simple enough to use immediately yet sufficiently flexible to form the center of a fairly complex network. It's a good choice for small installations.

DIGITAL PRODUCTS INC.

NetCommander NC16

by M. Keith Thompson

Offering many of the features of a full-scale LAN, Digital Products' 16-port NetCommander NC16 doesn't come cheap. But $3,450 will give you almost everything you could want in a data switch, including support for a data transmission speed of 115,200 bits per second.

Part of Digital Products' SubLAN series, the NetCommander NC16 data switch is a powerful unit for handling switching and traffic management with multiple Z80 microprocessors. Roughly the width of an AT Enhanced-style keyboard, the front panel of the unit has an activity light for each port and a status light that blinks at varying frequencies to indicate the data flow rate.

Inside, you'll find 1MB of RAM for print buffering (expandable to 4MB) and eight port expansion slots, each of which accepts a four-port serial or parallel card. The unit is available off-the-shelf in two different configurations: one with 16 serial ports, the other with 12 serial and 4 parallel ports. You can also order custom configurations of ports (in sets of four), but they

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must be purchased à la carte.

In all cases, the system handles connections between serial devices running at different speeds (up to 115,200 bits per second) and performs serial-to-parallel conversion as necessary. You use eight-wire modular telephone cables with RJ-11 plugs to communicate between the switch and each device. If you need more connections, you can cascade the NC16s together. The unit comes with a 1-year factory warranty (a 5-year extended warranty is available at extra cost), and technical support is offered through dealers.

WIRING ASSISTANCE

The NetCommander NC16 comes with several programs to ease the difficulties inherent in cabling serial devices together. The DOCTOR diagnostic program lets you test the connection between a workstation and the data switch and will suggest solutions to any problems it finds. Another program shows the status of the lines on your serial port, a nice extra for better troubleshooting.

For $3,450, Digital Products' 16-port NetCommander NC16 gives you support for 115,200-bit-per-second data transmission and many of the features you'd see on a full-scale LAN.

However, software installation is made somewhat difficult by the quirks of the installation and configuration program. For example, while the switch configuration program works well, it is very time-consuming to use. Instead of keeping the configuration information in a central location, the program creates a working disk, but only in drive A:. You must then copy the working disk around to the other computers on the network.

The configuration software lets you lock out certain connections between ports, but that's the extent of the security system built into the switch; you can't assign passwords to specific devices. The NetCommander does support hunt groups, however.

FACT FILE
EDITOR'S CHOICE

NetCommander NC16
Digital Products Inc., 108 Water St , Watertown, MA 02172; (800) 243-2333, (617) 924-1680
List Price: With 1MB of RAM, $3,450; 1MB memory upgrade, $925; *DC1* networking software, $150 per node or $1,195 for 16-node license
Requires: PC with 384K of RAM (640K recommended), DOS 3.0 or later.
In Short: A data switch full of options and features, NetCommander NC16 includes easy-to-use software and features commonly found in full-scale PC LAN software. It is, however, very difficult to set up.

CIRCLE **544** ON READER SERVICE CARD

PRINT ENHANCEMENTS

BigPop, the memory-resident utility that you use to make connections and control the switch, takes up about 70K of RAM. If you can't afford this much memory, you can also control the switch through commands embedded in print jobs or by typing the commands to the switch using a batch file.

BigPop gives you only limited control over the print queue in the buffer. You can specify multiple copies and pause for paper changes when you send the job, but once it's in the buffer, all you can do is cancel your last job; you can't view or hold individual jobs. However, the utility does offer a "printegration" feature that lets you take advantage of many printer functions—even if your applications do not—by adding the appropriate formatting commands to your jobs as they go to the printer. The software supports approximately 200 of the most popular printers, and a utility will help you build a file for your printer if it's not listed.

The system also comes with file transfer software, which includes a security system that lets each user assign a password to each directory or even to individual files. You can specify no access, read-only access, or full access. With the addition of Digital Products' *DC1* networking software (at an extra cost of $150 per node), you can make the NetCommander work much like a media-sharing network. To copy files, you'd simply assign a virtual drive letter to the target disk, then use the DOS COPY command to send the files over.

Digital Products offers a wide range of products for device sharing, and the NetCommander is a good choice if you need a versatile system with room to grow beyond peripheral sharing into a large file-sharing network. But let your dealer set it up—the installation process is simply too time-consuming and confusing for end users to handle without experience.

EQUINOX SYSTEMS INC.

Alternet

by M. Keith Thompson

Despite its relatively slow transmission rate of 19,200 bits per second, Equinox Systems' $995 Alternet can transfer files quickly and comes with impressive network-like software. The speed and ease of use of this eight-port MDX switch help make up for its lack of support for parallel ports and a print buffer.

The Alternet is an entry-level package from a company whose large family of connectivity products includes data switches and multiplexers that can support

Equinox Systems' $995, eight-port Alternet transfers files surprisingly quickly, since it transmits at only 19,200 bits per second. It lacks support for parallel ports, and has no print buffer.

thousands of nodes. The switch box is compact and should fit into most installations with ease. In place of the general-purpose microprocessor and support chips found in most competing data switches, you'll find a custom chip set optimized for serial data processing. And it seems this design really makes a difference—the system's throughput rating was higher than that of some systems running at twice its speed.

The Alternet makes use of six-wire telephone cables to tie workstations and serial devices to the data switch. You can double your connections to 16 by adding a second Alternet switch to the network, connecting it to a special link port on the first switch via an RS-422 cable that can be up to 5,000 feet long.

FACT FILE

Alternet
Equinox Systems Inc., 14260 S.W. 119th Ave., Miami, FL 33186; (800) 328-2729, (305) 255-3500
List Price: $995 (with null-modem cable).
Requires: PC with 384K of RAM (640K recommended), DOS 3.0 or later.
In Short: A fast and attractive small switch whose software is exceptionally easy to use. Its unique print spooling design lets you send jobs to any printer attached to any workstation on the network.

CIRCLE 545 ON READER SERVICE CARD

One thing you won't find in the Alternet switch box is a parallel port, but that doesn't mean you can't use parallel printers. Alternet lets you send your jobs to printers attached to remote workstations as well as to serial printers attached directly to the switch box.

MASTER WORKSTATION

Getting Alternet up and running is a breeze, thanks to its easy-to-follow installation programs. To configure the data switch, you designate one PC as a master workstation that will control the switch, and then run a program (catchily titled AHUBCFG) to name each port on the switch and to indicate the kind of device that is attached to it. The status screen lets you monitor the lines on the PC's serial ports, a feature that makes up for the lack of status lights on the Alternet switch box.

Like a number of its competitors, Alternet lets you designate hunt groups so that you can create pools of modems or other devices. But the Alternet goes one step further by letting you "camp on" to a group if all its lines are busy—the software will ring you back when a port is free. The switch's security system is elementary, however. You can designate only whether or not another user can get files from your computer; you can't protect individual directories or assign passwords to shared devices like modems.

Alternet's pop-up networking software really stands out for its features and ease of use. A menu-driven program occupying about 64K of RAM, it offers a full set of printer control, file transfer, and host communications functions. If you don't want to bother with the pop-up program, you can connect and disconnect to specific ports through batch file commands, making it easy to integrate Alternet with existing software applications.

The program's print control features are as complete as you might find in many high-end LAN systems. Not only can you change printers from within your application, but you also have full control over the print queue; can cancel, hold, or reprioritize jobs on any printer, and can designate multiple copies.

The file transfer utility is equally solid, letting you exchange files with other stations on the network. Files are received in the background so that the transfer doesn't interrupt your work. The software also has a simple electronic mail utility and includes terminal-emulation software that mimics TTY, VT52, and VT100 terminals; supports PC-to-host file transfers; and captures sessions to a log file.

Overall, Alternet makes a fast and reliable data switch network. Its well-designed configuration and operations software makes it easy to use, and its competitive price renders it an excellent choice for small networks.

FIFTH GENERATION SYSTEMS INC.

The Logical Connection

by M. Keith Thompson

The Logical Connection started life as a printer-sharing device, but by improving its operating software, Fifth Generation Systems has managed to turn it into a full-fledged eight-port data switch. At $695, it is one of the least expensive units we tested, but its slow speed makes it unsuitable for all but the lightest peripheral-sharing work.

The Logical Connection is about the size of a folded-up newspaper, with an external power supply that eliminates the need for a fan. It is based on a Z80 microprocessor and comes with up to 1MB of RAM for print buffering. The box has no lights to indicate which ports are active or when data is being transferred; all you're given is a Run light that flashes when the buffer is full and a Status light that blinks each time the switch receives a command. The unit comes with a 1-year factory warranty, and Fifth Generation offers unlimited free technical support, though it does not have a toll-free telephone line.

One of the least-expensive units we tested, the $695 Logical Connection communicates only at 9,600 bits per second. This data switch comes with four serial and four parallel ports.

The Logical Connection has a fixed quota of ports—four serial and four parallel—making it less versatile than some of the competition. Though its four RS-232 serial ports can be used for either input or output, two of the parallel ports are hardwired for output to printers, while the other two are designed only for input from other devices. All, however, are equipped with standard DB-25 connectors, so you can use ordinary parallel and serial cables to put the network together, or, with the appropriate connectors, ordinary phone cable or twisted-pair wire.

If you need a larger network, you can connect up to 45 switches together for a total network size of 315 stations. The system uses a proprietary communications scheme (based on the RS-485 standard) for tying the boxes together, which lets you use longer cables than the standard

DATA SWITCHES: SUMMARY OF FEATURES

The following terms in this features table may be unfamiliar to users with limited knowledge of larger (or older) computers:

Spools to disk. When the internal-print job buffer is full, print spooling capabilities allow a data switch to send the job to a hard disk, storing it there until the printer becomes available. Without print spooling, the job would fail.

Translates baud rates. Different equipment can communicate at different speeds. There are four main serial baud rates: 9,600, 19,200, 38,400, and 115,200 bits per second. If a data switch cannot translate baud rates, operating will be much more complex; users or administrators will have to arrange the system with care to keep transmission speeds consistent.

	Systemizer Plus Applied Creative Technology Inc. $399	**Buffalo SL** Buffalo Products $500	**BayTech Model 24** Bay Technical Associates Inc. $695	**The Logical Connection** Fifth Generation Systems Inc. $695	**Data Manager 4 x 4** Integrated Marketing Corp. $895	**Alternet** Equinox Systems Inc. $995
Dimensions (HWD, inches)	1.9 x 8.0 x 8.4	4.5 x 12.0 x 7.8	3.5 x 18.8 x 10.0	0.9 x 14.4 x 4.2	3.0 x 16.5 x 11.25	2.6 x 8.1 x 6.5
Processor type	64180	NEC V20	Z8001	Z80	Z80	Custom
Ports per switch (base/maximum)	1/1	10/10	0/24	8/8	8/8	8/8
Printer buffer size (base/maximum)	64K/1MB	None/4MB	512K/4.5MB	256K/1MB	256K/1MB	N/A
Spools to disk	○	○	○	○	○	●
Supports parallel ports	●	●	●	●	●	○
Supports RS-422 ports	○	○	●	○	○	○
Maximum speed (bits per second)	38,400	19,200	38,400	9,600	19,200	19,200
Translates baud rates	●	●	●	○	○	○
Hunt groups	●	●	○	○	○	●
Log-in passwords	●	●	○	○	○	●
Device passwords	●	○	○	○	○	●
File transfer software	●	○	○	○	○	●
Background file transfers	○	○	○	○	○	●

PC—Editor's Choice ●—Yes ○—No N/A—Not applicable: this product does not use a printer buffer.

FACT FILE

The Logical Connection
Fifth Generation Systems Inc., 11200 Industriplex Blvd., Baton Rouge, LA 70809; (800) 873-4384, (504) 291-7221
List Price: With 256K RAM and one null-modem cable, $695; with 512K RAM, $795; with 1MB RAM, $1,095.
Requires: PC with DOS 2.0 or later.
In Short: This glorified printer box is an inexpensive way to network, but its slow speed (9,600 bits per second) and its lack of baud rate conversion make it best suited for sharing low-speed devices like modems and printers.

CIRCLE 848 ON READER SERVICE CARD

RS-232 standard supports.

To install the software, you simply copy the files from the utility program disk to your hard disk and run the setup program to define and name the ports, specifying which of the devices are attached to each one.

You use a 24K memory-resident program called POPLC to make connections between devices and to monitor the switch configuration. The hotkey is Alt-L, but you can change it if necessary to avoid conflicts with other programs. You can also make and break connections using nine-character commands embedded in print jobs or in files that you send to the switch over the serial or parallel connection.

DISAPPOINTING PRINT SPOOLER

Unfortunately, the print spooler is primitive. Once the buffer is full, the switch sends a "printer busy" signal back to the workstation. Although you cannot spool jobs onto the workstation's disk for later queuing, you can store printer commands in the switch memory, from there they will be sent to the printer with each job. Fifth Dimension does not supply any file transfer software, but you can easily use a third-party program such as *The Brooklyn Bridge* to do this.

The Logical Connection manages to do an adequate job of sharing peripherals among a few PCs for a low cost. But it's not very big on network management features, and its slow data transfer rate of 9,600 bits per second will keep you waiting on your file transfers. You should only consider this switch if your needs are very simple.

INFOTRON SYSTEMS CORP.

Commix 32

by M. Keith Thompson

Infotron Systems Corp. specializes in high-end communication products, so it's not surprising that its Commix 32 is one of the most capable and flexible data switches

Hunt groups. A switch that supports hunt groups allows the user to select a device, then connects the user to the first available port with a device of that type. A hunt group might contain three identical modems or two identical printers attached to a data switch.

Log-in passwords can be used to restrict access to the data switch.

Device passwords. Some switches can be programmed to include a second level of password protection restricting access to specific devices. This feature can be used to protect resources attached to outside telephone lines, such as modems.

	FocalPoint Plus Wespercorp $1,000	Alliance Avatar Corp. $1,195	Bytelink Protec Micro-systems Inc. $1,495	PC 1082 MainStreet Newbridge Networks Inc. $1,600	Master Switch (N Series) Rose Electronics $1,895	INC-64 Intelligent Network Controller Western Telematic Inc. $2,115	PC NetCommander NC16 Digital Products Inc. $3,450	Commix 32 Infotron Systems Corp. $3,495
	3.5 x 8.25 x 5.0	2.0 x 12.0 x 9.8	3.8 x 18.8 x 7.8	1.9 x 7.5 x 10.5	3.5 x 10.5 x 5.0	14.0 x 19.0 x 8.5	4.0 x 17.0 x 9.0	6.5 x 17.5 x 15.5
	Z80	Custom	Z80	Motorola 6809	Intel 80C31	Motorola 6800	Z80	Motorola 6502
	8/8	8/20	12/12	8/8	17/17	8/64	16/18	16/32
	256K/1MB	N/A	1MB/2MB	256K/1MB	64K/4MB	256K/2MB	1MB/8MB	1MB/1MB
	○	●	○	○	○	●	○	○
	●	○	●	●	●	○	●	○
	○	○	○	●	●	●	●	●
	19,200	115,200	38,400	19,200	115,200	38,400	115,200	19,200
	●	●	●	●	●	●	●	●
	●	●	●	●	●	●	●	●
	○	●	●	●	○	●	○	○
	○	●	○	●	○	●	●	●
	●	●	○	●	●	●	●	●
	○	●	○	●	●	●	●	●

we tested. And at $3,495 for 16 ports, it should be. This is definitely a switch for demanding jobs.

The Commix 32 is a hefty unit, similar in size, shape, and construction to an AT-class PC. Its 2-amp internal power supply requires a fan, which makes it relatively noisy, so you may prefer to install it in an out-of-the-way place. Inside, you'll find 8 vertical expansion slots, each of which can hold a 4-port serial card. The smallest configuration of the unit comes with 4 cards (16 ports), and you can expand it to up to 32 ports, at $100 for each 4-port card.

The unit is refreshingly free of DIP switches and jumpers. The helpful 2-line by 20-character LCD display on its front panel gives you a more detailed view of what is going on inside than the usual array of LEDs. In conjunction with three buttons, you can use this display to program the switch from the front panel, to make and break connections between ports, to run diagnostics, and to reset the switch. Additionally, LEDs in front of each expansion slot indicate which slots have cards installed. The unit carries a 1-year manufacturer's warranty, and the company offers worldwide field service as well as free support over a toll-free line.

FACT FILE

Commix 32
Infotron Systems Corp., LAN Systems Division, 130 Gaither Drive, #116, Mount Laurel, NJ 08054; (800) 423-8044, (609) 722-5575
List Price: With 16 serial ports, $3,495; with 32 serial ports, $4,795; four-port serial cards, $400 each; printer card with 1MB RAM, 2 serial ports, $945.
Requires: PC with DOS 2.0 or later.
In Short: A large, industrial-grade data switch that offers excellent expandability but requires more time and experience to install and program than the others. The ability to connect switches over a unique high-speed coaxial cable link makes the Commix 32 especially suited for large networks of widely separated units. The Commix 32 excels at file transfer and communications tasks, but stumbles in its printer management.

CIRCLE 847 ON READER SERVICE CARD

HIGH-SPEED LINKING

One of the Commix 32's slots is designed to hold a special link card that you can use to connect up to 30 switches together over RG-58 (thin Ethernet) coaxial cable. The link uses a high-speed proprietary signaling scheme based on Ethernet, which makes it possible to create large data switch networks with long cable runs between the boxes.

On the individual switch, you connect workstations and other devices to the switch using full-scale eight-conductor serial cable with RJ-45 modular telephone jacks. This makes the physical process of

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Performance Comparisons using PC Labs Benchmark Series Release 4:

	NOP	80286 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 286/12 Desktop	2 81	4 78	18 84	0 72
IBM PC AT (8MHz)	4 23	8 96	35 60	1 32
IBM PS/2 Model 50	3.35	7 20	28.34	1.05

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Performance Comparisons using PC Labs Benchmark Series Release 4:

	NOP	80386 Instruction Mix	Floating Point Calculation	Conventional Memory
ZEOS 386/16 Desktop	2.10	3 58	13 62	0 58
IBM PS/2 Model 70-E61	2 09	4 11	16 14	0 77
Compaq Deskpro 386/16	2.09	4.12	15.47	0.75

PC MAGAZINE EDITOR'S CHOICE February 28, 1989

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wiring the network more complicated than it is with some simpler, plug-and-play competitors. You should consider getting an experienced installer if you're not well versed in the mysteries of serial-line troubleshooting.

SOFTWARE LIMITATIONS

The Commix 32's installation program includes a good user interface and options to change the screen colors and the memory-resident control program's hotkey. However, it does not create a directory on your hard disk or add the necessary commands to the CONFIG.SYS and AUTOEXEC .BAT files. These steps are well documented, but the installation program should do them for you.

Offering an excellent electronic mail program, the $3,495, 16-port Commix 32 from Infotron is an industrial-grade data switch. It comes with good file-transfer and adequate printer control software.

The switch configuration program betrays its origins in the dumb terminal world. Though menu driven, it is slow, and you seem to spend a lot of time going from menu to menu, pressing one key at a time and waiting for the screen to be redrawn. The program does let you designate hunt groups for easier access to a pool of modems or printers. A console password protects the switch configuration from unauthorized modification.

The print spooler is quite limited. It can manage only two printers at once, and when the 1MB print buffer fills up, it sends a "printer busy" signal instead of spooling the jobs to the hard disk. However, the memory-resident file transfer program, which lets you transfer files to and from other computers in background mode, is effective, fast, and efficient and uses only 40K of RAM.

Infotron also throws in a basic VT100 terminal-emulator package that you can use for communicating with a variety of hosts and with X.25-based wide-area networks. The switch responds directly to Hayes AT commands, so you can use standard communications software for direct file transfers as well as for modem links.

The best part of the software is the excellent electronic mail program. It comes with its own text editor, stores and forwards messages, and supports distribution lists.

Overall, the Commix 32 is an industrial-grade data switch that excels at file transfer and communications tasks. Its proprietary switch-to-switch cabling scheme is a plus for large networks, and it offers excellent support for X.25 and modem connections to wide-area networks. Its printer management features could be better, though.

INTEGRATED MARKETING CORP.

Data Manager 4 × 4

by M. Keith Thompson

At $895, Integrated Marketing Corp.'s eight-port Data Manager 4 × 4 might initially seem to be a bargain. But you should look this gift horse very carefully in the mouth—its lack of control software and its design flaws will make up in trouble what you might save in cash.

The Data Manager 4 × 4 is well enough constructed, and it uses a capable Z80 processor to handle its data traffic. It comes with four serial and four parallel ports, and its 256K print buffer is expandable to 1MB. Its serial ports use standard male DB-25 connectors, and its four parallel ports use Amphenol connectors, so you can easily hook your workstations to the switch using standard PC serial and parallel printer cables. This is a perfectly adequate solution for small networks, though not as neat or as flexible as using telephone-type cable (and, of course, to connect printers to the switch, you need a special cable with Amphenol connectors at both ends). You can cascade up to 7

Offering four serial and four parallel ports, the $895 Data Manager 4 × 4 supports speeds from 300 to 19,200 bits per second, but cannot adjust for devices running at different speeds.

switches for a total of 49 devices on the network. The unit even supports hunt groups.

The problems begin when you try to use the switch. Although the Data Manager's speed is adjustable over a range of 300 to 19,200 bits per second, you can't change these parameters through software. Instead, you must change the speed by moving internal hardware jumpers, and you must change other configuration parameters through DIP switches located under a flip-up door in the cabinet.

Since the switch cannot adjust for devices running at different speeds, you must carefully set up your batch files and script files to ensure that the settings on your ports and devices match. And since IMC doesn't include any control software, you must make your connections by sending cryptic codes to your serial ports using statements in batch files or BASIC programs. The unit's printer control program

FACT FILE

Data Manager 4 × 4
Integrated Marketing Corp., 1031 E. Duane Ave., Suite H, Sunnyvale, CA 94086; (800) 537-5999, (408) 730-1112
List Price: With 256K RAM, $895; 256K memory upgrade, $200 (varies with DRAM prices).
Requires: PC with DOS 1.1 or later.
In Short: This low-end data switch requires far too much effort to configure and use, and its documentation is poor. File transfer seems to have been an afterthought.

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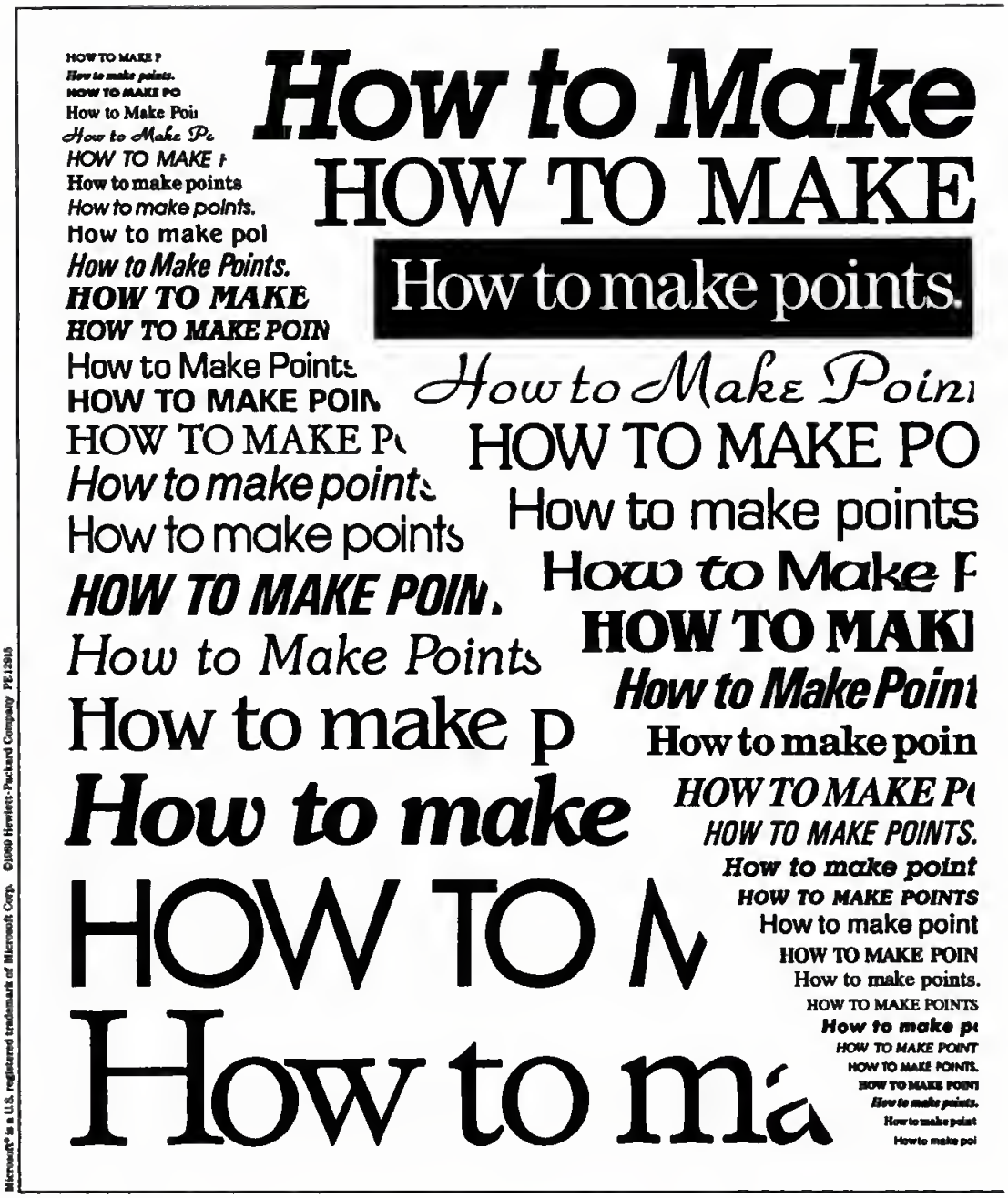

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does little more than let you print multiple copies.

Though this approach has the advantage of not using any RAM in your workstation, altogether it's not worth the savings. To top it off, the documentation we received was incorrect, incomplete, and difficult to understand. Our PC Labs crew had trouble setting up this switch and we think the typical user would be thoroughly stumped.

The Data Manager 4 × 4 looks like a simple printer-sharing box masquerading as a data switch. In a field of simple and relatively trouble-free devices, its difficulty of installation and use and its illegible documentation make it a poor choice for most users.

NEWBRIDGE NETWORKS INC.

1082 MainStreet

by Randol Tigrett

Using a Newbridge Networks data switch is like being taken for a drive on a cool sunny day—you can look out the window and enjoy the view while the driver does all the work. Though its throughput is on the slow side, the $1,600 eight-port 1082 MainStreet gives you real networking power combined with exceptional ease of use.

At the heart of the switch is Newbridge's exemplary EasyStreet software, a memory-resident utility (taking 70K of RAM) that lets you configure the switch, make connections, and transfer files from machine to machine with ease.

FACT FILE
EDITOR'S CHOICE

1082 MainStreet
Newbridge Networks Inc., Hallmark Bldg., #160, 13873 Park Center Rd., Herndon, VA 22071; (703) 834-3600
List Price: With 256K RAM, $1,600; 1MB RAM, $2,100; eight-port serial I/O card, $625; *EasyStreet Net1* software, $450 per switch; NetBIOS emulator software, $720 per switch.
Requires: PC or terminal; EasyStreet and *EasyStreet Net1* require PC with 256K RAM (640K recommended), DOS 2.0 or later.
In Short: A well-designed switch that can grow with your needs, the 1082 MainStreet offers unique configuration and diagnostic features.

CIRCLE 603 ON READER SERVICE CARD

You can use EasyStreet to set up hunt groups, and users can queue up to connect whenever a port becomes free. For each user, you can define a default connection (for example, to a printer port) that will be initiated automatically whenever the DTR (Data terminal ready) line goes high, or whenever data appears on the line. These are versatile features that let you connect just about any type of computer to the network without modifying its software. Finally, you can connect any two ports from a third port; this is useful for setting up data collectors, which operate automatically as soon as the connection is made.

Physically, the 1082 is a slim, wall-mounted unit housing eight serial and two parallel ports. Besides its Motorola 6809 processor, it contains a 256K print buffer, expandable to 1MB. It can configure its own serial ports by testing the pins to determine which pins are active and whether a port is connected to a DCE (data communications equipment) or DTE (data terminal equipment) device. If it's an output device, the switch can also set the bit-per-second rate and other serial communications parameters. This makes wiring and configuration, always the most difficult part of getting a serial network up and running, almost completely automatic. It uses eight-wire serial cable with RJ-45 modular telephone connectors.

TROUBLESHOOTING AIDS

Newbridge has been thoughtful in its provisions for troubleshooting. You can use EasyStreet's Light Box as a kind of on-screen breakout box to monitor the data flow through the various port connections. The 1082 also has LEDs on its case that indicate which ports are active, and it comes equipped with switches that reset the unit to the manufacturer's original specifications.

EasyStreet comes with background file transfer software that gives it very respectable performance. At 19,200 bps and with no load on the switch, it took only 46 seconds to complete a 50K file transfer. But users with more demanding needs will want to buy *EasyStreet Net1*, Newbridge's networking software.

EastStreet Net1 makes large networks of cascaded data switches practical. For an extra $450 per node, it lets you interconnect up to 1,536 ports on 32 data switches (Newbridge offers a larger switch called the 1032 MainStreet that can be expanded to up to 48 ports.) You can share any device on any switch transparently simply by selecting its name. This ease of use is made possible by *Net1*'s Easymap feature, which collects the configuration information from all of the interconnected data switches as they are powered up and uses it to pick out the fastest connection route. If a data switch is busy or down, *Net1* automatically reroutes the connection.

Net1 also offers an enhanced security system, and Newbridge is working on a NetBIOS emulator that will support messaging, printer redirection, and virtual drives. Such an emulator would make *Net1* nearly the equivalent of a full-fledged media-sharing network operating system.

The $1,600, eight-port 1082 MainStreet switch from Newbridge Networks supports parallel and serial ports, but its throughput is on the slow side. It comes with a good software package called EasyStreet.

The 1082 MainStreet offers unique configuration and diagnostic features that redefine the limits of data switch networks. Thanks to its high quality and thoughtful engineering, this switch will make an excellent foundation for the network of a growing business.

PROTEC MICROSYSTEMS INC.

Bytelink

by M. Keith Thompson

The Bytelink from Protec Microsystems is a versatile switch, offering fast file transfers at speeds of up to 38,400 bits per second and a variety of serial and parallel

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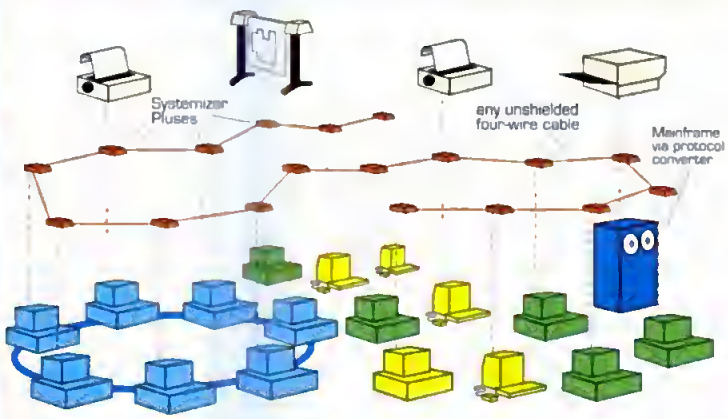

Example: 17 micros (mixed brands, some on a LAN) and a mainframe, each equipped with a Systemizer Plus, sharing 3 printers, a plotter, and EMAIL.

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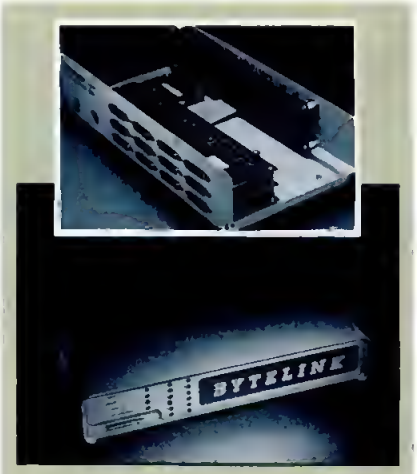

Available with up to 12 serial or parallel ports, the $1,495 Bytelink data switch from Protec Microsystems supports file transfer speeds of up to 38,400 bits per second.

combinations for its 12 ports. But the $1,495 switch's lack of installation instructions and shortage of features overshadow these advantages.

Constructed sturdily from heavy-gauge metal and powered by a 43-watt external supply that allows quiet, fanless operation, the Bytelink is controlled by a 6-MHz Z80 processor. It can take up to 12 serial or parallel ports in groups of four. Its parallel ports can be configured either for output to a printer or for input from a workstation. Both types of ports come with standard DB-25 connectors, but you can always use conversion boxes to wire the network with telephone cable. To build larger networks, you can link the switches together since the software supports up to 10 switch boxes for a total of 110 devices.

You can build large networks with Bytelink by linking the switches together. The software supports up to 10 such links for a total of 110 devices.

The Bytelink comes with 1MB of RAM

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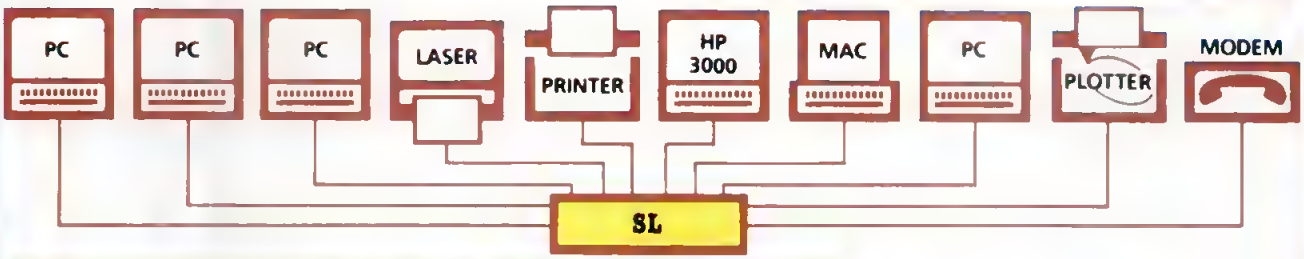
If you don't need E-mail or access to shared files, the SL is an alternative to a LAN at a fraction of the cost. **When you compare the price and capabilities of the SL with any similar devices, we believe you will agree with thousands of well-informed professionals that the SL is the best value available anywhere!**



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Type Director Compatibility Information.
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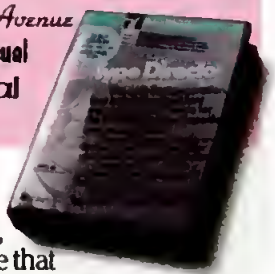

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CIRCLE 200 ON READER SERVICE CARD

for a print buffer, expandable to up to 2MB. It also comes with a pop-up menu and terminal-emulation software. It has some switch allocation options, and the control software lets you flush your own print buffer but does not let you cancel or hold individual print jobs.

The unit comes with a 1-year warranty and can be serviced either by authorized service centers or directly by the factory. The company offers unlimited telephone support but does not as yet have a toll-free line.

SETUP PROBLEMS

The Bytelink system does not come with installation software, nor even with documentation explaining how to copy it onto the hard disk or how to add the appropriate lines to your AUTOEXEC.BAT file. This is not a difficult job for anyone with basic experience with PCs, but that's no excuse for not documenting it. Once you've got the software on your first workstation, however, configuring the switch is relatively easy. You can't set up hunt groups or passwords in the switch, though.

FACT FILE

Bytelink
Protec Microsystems Inc., 3274 St. Martin Blvd. W., #100, Laval, PQ, Canada H7T 1A1; (514) 682-6461
List Price: $1,495
Requires: PC with DOS 2.0 or later.
In Short: The Bytelink's lack of installation instructions and features overshadows the fast (38,400-bps) data transfer rate. Not recommended for a first-time user without some experienced guidance.

CIRCLE 549 ON READER SERVICE CARD

Protec thoughtfully supplies both memory-resident and nonresident versions of its control software. Though the resident version takes up only 20K of RAM, its hotkey (Shift-PrtSc) cannot be changed, so you may prefer to use the nonresident version. Both programs are identical, with an easy-to-use point-and-shoot menu structure that lets you make and break connections. You can also control the switch through embedded commands. Though Protec does not include any file transfer software with the switch, you can use third-party programs without difficulty.

Protec needs to spend some more time on the software end of things if its switches are to catch up with the leaders in the field. The lack of hunt groups, security passwords, and file transfer software does not mean it can't be used as the center of a network, but it does mean you have to make an extra effort to supply these functions.

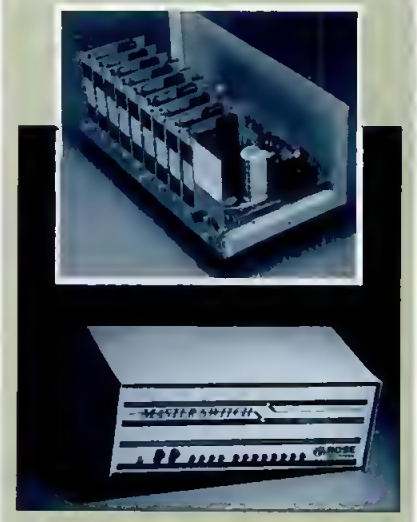
ROSE ELECTRONICS

Master Switch (N Series)

by Randol Tigrett

The Master Switch family of data switches from Rose Electronics caters to your every whim. From its sizeable array of products you can put together just about any combination of connectors, serial/parallel port options, and internal memory buffer options.

We reviewed the N Series, a solid $1,895 switch offering 115,200 bits per second transmission and the fastest file transfer speed of all the data switches we reviewed. Based on an 8-bit Intel 80C31 processor running at 15 MHz, the unit offers 16 serial ports (each on 2-port cards), 1 parallel port, and 64K RAM. The steel construction of the unit gives it the look and feel of a commercial-grade tool box. Status lights on the front panel of the data switch help you monitor the activity of



Able to transfer files faster than all of its peers, the $1,895 Master Switch (N Series) from Rose Electronics offers 16 serial ports (each on two-port cards) and one parallel port.

each port. You can install up to 4MB of RAM for print buffering.

Unlike most switches, you can install either RS-232 or RS-422 serial ports. For the serial connections, you can use either RJ-45 or RJ-11 telephone cable containing at least four wires. The system also includes a built-in parallel output port to which you can attach a printer; if you need more than one printer, however, you'll have to attach any others to one of the serial ports through an external parallel-to-serial converter.

Unfortunately, though you can connect Master Switch units together, it's not very practical to do so. Since the links between the switches operate on a first-come-first-served basis, only one PC can access the other switch at any time. Moreover, the integrated software that comes with the unit does a poor job of managing the switch-to-switch connection, and it's possible for another user to inadvertently disrupt the connection.

FACT FILE

Master Switch (N Series)
Rose Electronics, P.O. Box 742571, Houston, TX 77274; (800) 333-9343, (713) 933-7673
List Price: $1,895; 256K memory upgrade (for upgrades to 1MB), $100; 1MB memory expansion board (for upgrades beyond 1MB), $400; *MasterNet*, $100 for four nodes.
Requires: MasterLink and *MasterNet* software require DOS 2.10 or later.
In Short: A commercial-grade data switch with excellent performance and a long list of options and diagnostics, but limited in its ability to interconnect switches

CIRCLE 550 ON READER SERVICE CARD

SOFTWARE OPTIONS

You can set up hunt groups for the Master Switch, but it has no security system of its own. It does come with MasterLink software to help you make connections. A memory-resident program that takes 12K of RAM (though you can save 7K by loading it into the foreground), MasterLink uses the PC's function keys to send commands to the Master Switch.

Instead of using the TSR, you can embed switch control commands in your print jobs, and Rose Electronics includes a Send utility that lets you transmit commands directly to the switch using batch files. MasterLink gives you excellent control over your print jobs, allowing you to cancel them individually, change their priority, and hold or release them. You can support remote PCs through auto-answer modems by utilizing MasterLink's Add Remote menu option.

FILES TO GO

For other network functions, Rose offers *MasterNet*, which gives you background file transfer, e-mail, and print control utilities for just $100 per four nodes. *MasterNet* uses 60K of RAM, but it compensates for this extravagance by giving you error messages in intelligible English.

The file transfer menu in *MasterNet* borrows much from DOS in its operating methods. It uses familiar commands like COPY, RENAME, and ERASE and supports the DOS wildcard characters. Unlike many file transfer programs, it does not limit you to transfering files to and from the workstation you're running it on; you can copy files between any two workstations from a third, provided that *MasterNet* is resident on all of them. Since you can copy files to any DOS device name, you can send your print jobs to a printer attached to a remote workstation, though you can't spool them.

MasterNet's e-mail function lets you send a message to any other *MasterNet* PC on the network. The recipient will see a flashing message and hear a chime when the message arrives. The mail is then appended to the end of an e-mail system text file for archiving purposes. You can also send brief "rude" notes that appear on the top of the receiving screen. The program supports only ASCII text files; you cannot attach binary files such as spreadsheet or database files to e-mail messages.

The Master Switch is a commercial-grade unit with a long list of options and diagnostics, and its capable software makes it an obvious candidate for large networks. But glitches in its ability to interconnect switches and its limitation to just one parallel port reduce its usefulness.

WESPERCORP

FocalPoint Plus

by Mike Byrd

Wespercorp proves that good things really can come in small packages. Its $1,000 FocalPoint Plus intelligent data switch manages to squeeze eight ports and a wealth of software, including electronic mail, into an off-white aluminum box just 8¼ by 3½ by 5 inches (HWD).

The FocalPoint Plus is well designed for independent use, with a two-line LCD display and five membrane keys on its front panel that you can use to configure the switch. Three LEDs indicate power, data activity, and error status. The basic unit comes with 256K of RAM for print buffering, and you can expand this to 1MB in 256K increments. Memory upgrades are not available. A Z80 processor operating at 6.144 MHz handles the switching chores and throughput. The unit carries a 1-year factory warranty, and Wespercorp offers unlimited technical support over a toll-free line.

The $1,000 FocalPoint Plus from Wespercorp is able to transmit data at rates up to 19,200 bits per second and comes with six serial ports, one parallel output port, and one parallel input port.

The FocalPoint comes with 6 serial ports which can run at rates up to 19,200 bits per second. To save space, only 2 of them have standard male DB-25 DTE connectors. The other 4 have AT-type male DB-9 connectors, which might complicate your cabling scheme. The system also comes with 1 parallel output port (with a standard 25-pin female connector) and 1 parallel input port attached to a 36-pin Amphenol input connector such as you'd find on a parallel printer.

QUALITY PROBLEMS

Like most of the data switches in our review, installing the system is simply a matter of plugging in the cables. But it took us a while to get to that point since the first

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- TOPS can be configured as a distributed, dedicated, or combination network.

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sun

unit shipped to us had a defective power switch, while the second unit failed its own memory bit check at power-up. The third unit performed flawlessly, however.

You can configure the eight ports on the switch using the membrane keys on the front panel, or you can use the start-up program that comes with the switch to configure it from your PC. The latter option lets you save multiple configurations on-disk for easy use in the future. This program also acts as a tutorial, though it is too elementary to be of much assistance. The help messages, available from each function, are much better.

The FocalPoint Plus comes with a 5K memory-resident control program called HotSwitch, which you can use to select printers from within your application programs.

The switch doesn't allow you, however, to control the print queue from your workstations or even cancel your last job; the best you can do is to turn off the unit, a drastic step. The system supports hunt groups but not security passwords.

FACT FILE

FocalPoint Plus
Wespercorp, 17032 Murphy Ave., Irvine, CA 92714; (800) 854-8734, (714) 261-0606
List Price: With 256K RAM, $1,000; with 512K RAM, $1,235; with 1MB RAM, $1,575.
Requires: PC with DOS 2.1 or later.
In Short: This small but powerful switch comes with a complete set of basic software, including e-mail features. Its English-like command language makes customization quite easy, even for heterogeneous networks.

CIRCLE 601 ON READER SERVICE CARD

BUILT-IN SOFTWARE

Unlike most data switches, which depend upon software for file transfer, the FocalPoint Plus has built-in firmware to transfer files between configured PCs and to act as an elementary messaging system. You access Resource-Net through a standard communications program such as *Crosstalk* or *ProComm*; you simply start the software, then press @ three times until the Resource-Net menu appears.

Transferring files with Resource-Net is similar to transferring files over a null-modem cable, except that FocalPoint Plus lets the two workstations operate with different speeds and handshaking parameters. Since the software uses industry-standard protocols such as Kermit or X-modem that are independent of the particular computer, Resource-Net can transfer data between dissimilar systems such as Macintoshes and PCs with little trouble.

You can perform most of Resource-Net's functions from its menus, but what really makes it shine is its powerful, English-like dot command language. With this language, you can build a potent series of batch files to tailor the system to your applications.

Resource-Net's e-mail system is capable enough, though limited in its functions. It allows you to send a text message to another station, where the message is stored in the RAM buffer of the switch and will remain there as long as the unit has power from the wall or from its internal battery. When the recipient next logs on, the switch indicates that a message is waiting to be retrieved.

With its built-in file transfer and e-mail facilities and its relatively sophisticated macro-control capabilities, the FocalPoint Plus offers a big punch in a small package. It can be an excellent choice for a small office network where printer sharing is not important.

A new product in need of some fine-tuning, the INC-64 from Western Telematic is able to support up to 64 ports; the base, 8-port version of the switch costs $2,115.

WESTERN TELEMATIC INC.
INC-64
by Mike Byrd

Western Telematic's intelligent network controller INC-64 bridges the gap between intelligent data switches and full-scale networking. A highly sophisticated device that supports such advanced options as audit tracking and multiplexing, the INC-64 can be cost-effective for large networks. But its poor performance (it was the slowest unit on our throughput tests despite its high speed of 38,400 bits per second) and its failure to work with parallel ports may give you pause.

The INC-64 comes in a large, two-tone gray case, that is ideal for installation in a central telephone closet. The standard unit includes eight ports and terminal software. Its internals are almost completely modular, with a card rack holding the power supply, the control module (based on a Motorola 68000 microprocessor running at 10 MHz), and up to eight eight-port serial modules. You can even beef up your unit by adding a second power supply module in place of one of the serial cards. Outside the cabinet, you can add a host of other options, including external line drivers that convert the RS-232 signal into RS-422 for long cable runs. You also can add high-speed on-campus multiplexers that you can use to consolidate the output from an eight-port card into two composite RS-422 lines that can be used for long-distance transmissions.

BUFFERING ON CARDS

Each eight-port card has a 256K spooling buffer that can be used for queuing print jobs as well as for handling speed conver-

FACT FILE

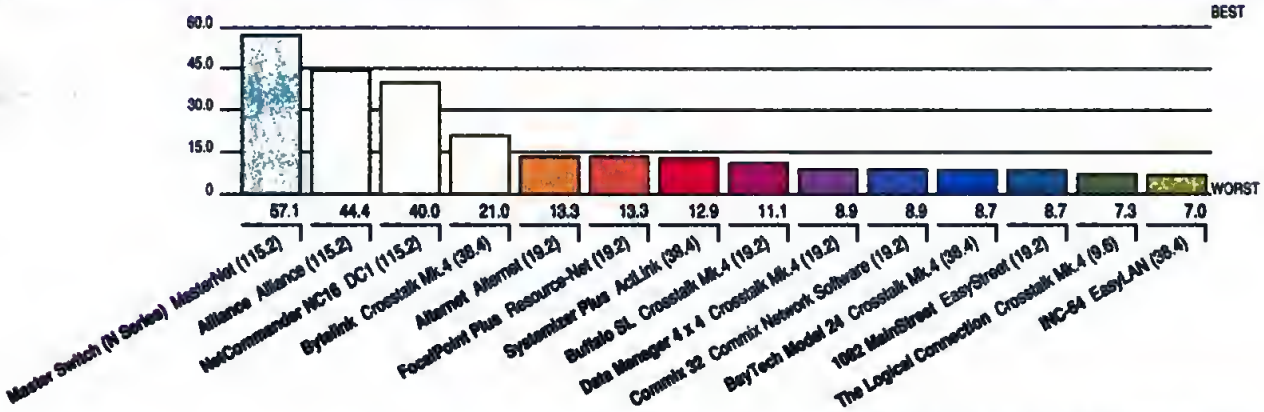
INC-64 Intelligent Network Controller
Western Telematic Inc., 5 Sterling, Irvine, CA 92718; (800) 854-7226 (outside Calif.), (714) 586-9950
List Price: $2,115; eight-port expansion card, $725; file transfer software, $250 for four users.
Requires: PC with DOS 2.0 or later.
In Short: A robust switching box offering interactive file sharing, port expansion, peripheral sharing, e-mail, broadcast, audit trail, and system security, the INC-64 is still a new product. It is designed for larger installations.

CIRCLE 602 ON READER SERVICE CARD

PERFORMANCE TESTS: DATA SWITCHES

Data Switch File Transfer Test

Throughput (kilobits per second)



In these graphs, each product name is followed by the file transfer software used for testing, and by the transmission rate in kilobits per second.

To test the throughput capabilities of these data switches, we used a 50K data file that resists compression algorithms and moved it from the virtual disk of a 12-MHz Dell System 200 to the virtual disk of an identical machine. If the vendor supplied file transfer software, we used it. Otherwise, we used DCA's *Crosstalk Mk.4* with the Kermit file transfer protocol.

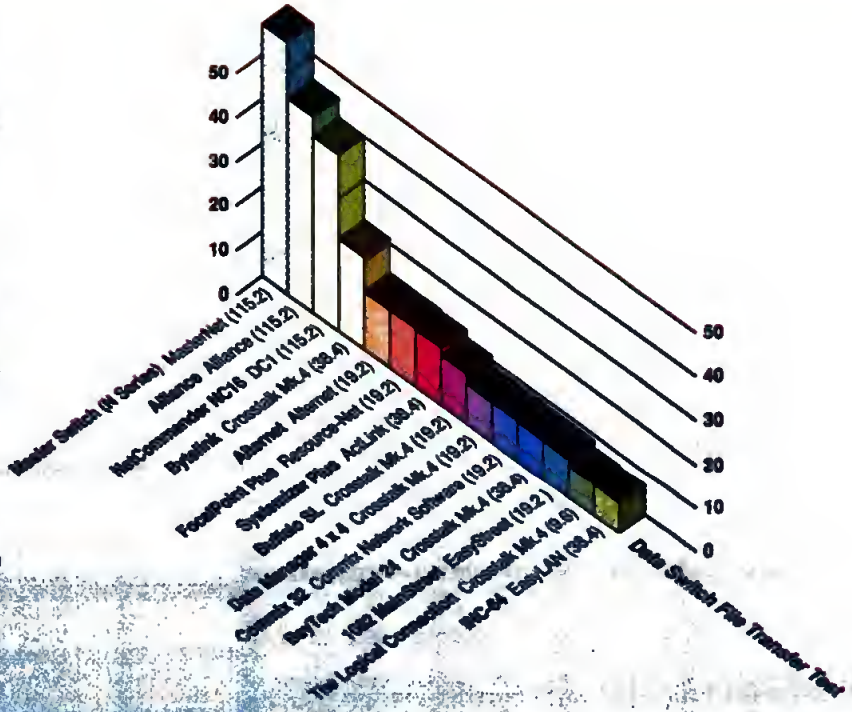
The significant differences shown in the performance tests resulted primarily from the switches' different top transmission speeds. Some machines, like the Alliance, allowed selection of an RS-232 transmission speed of 115.2 kilobits per second. Many other data switches can handle a top transmission speed of only 19.2 kbps. One data switch, the FocalPoint Plus, was not able to transmit at its rated maximum speed of 38.4 kbps without significant errors, so the test was performed at the next lowest speed setting.

The throughput differences reflect both the switches' internal architecture and the communication software used for the file transfer. Internal software runs in each switch, and file transfer software runs on each PC. A switch's throughput depends more on the code in these programs than on the type of processor or integrated circuits it uses.

It must be emphasized that many PCs and other RS-232 devices cannot effectively use an RS-232 port at speeds over 19.2 kbps. Some older 8088-based PCs have trouble handling serial data at speeds over 9.6 kbps. But many people do have newer PCs with high-speed 80286 and 80386 processors; they can use the throughput these switches provide.

The presence of electrical impulses and fields from many sources may affect how far you can push data over a cable at any given speed, so we ran a validity check of the timed file transfer tests at 115.2 kbps. Our test of the highest speed that RS-232 devices can use involved stringing together four 15-meter RJ-45 cables, draping the cables over operating PCs and across AC power wiring, and rerunning the file transfer tests at 115.2 kbps. We saw no degradation over this cable run, so we feel that these speeds are valid and practical in many installations.

PERFORMANCE TESTS: COMPOSITE VIEW



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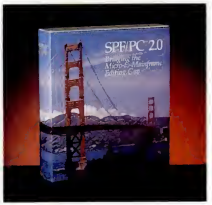

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CIRCLE 188 ON READER SERVICE CARD

sion and for flow control. This design, which buffers each individual port, makes the unit of special benefit in data acquisition applications. The INC-64 accepts return messages from plotters and other bidirectional devices and lets you set up groups of PCs or terminals to share a given printer.

A replaceable lithium battery furnishes backup power for the port configurations, the 32K of stored message memory, and the system clock. The ports connect to workstations and serial devices over ordinary twisted-pair wiring or standard RS-232 cabling. For connectors, you have the option of using either standard DB-25 connectors, RJ-11 modular telephone jacks, or telephone-type punch-down blocks, which you can use to connect to the twisted-pair wiring in your walls through the connector blocks in your telephone closet.

You log in directly to the INC-64's controller. Its menu-driven configuration software lets you name each of the ports and set up its serial communication and security parameters.

The INC-64 comes with a 3-year factory warranty, and the company offers unlimited free technical support over a toll-free telephone line. Western Telematic also has a 30-day unconditional return policy, and it guarantees that any repairs after the warranty expires will not cost more than 15 percent of the unit's original prices.

CENTRAL CONFIGURATION

To configure the ports, you log in directly to its controller, using the terminal-emulation software that comes with the switch. (The same program, installed as a 10K memory-resident utility, is used to connect

PC MAGAZINE EDITOR'S CHOICE

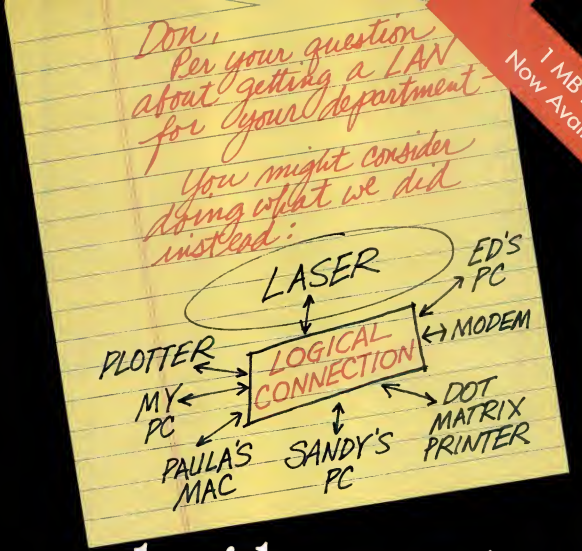
- **NetCommander NC16**
- **1082 MainStreet**

Our reviewers had several favorites in this series of data switches, and trying to strike that delicate balance between simplicity and flexibility became a matter for heated discussion.

The clear choice for a highly complete and flexible system goes to the NetCommander NC16 from Digital Products. Aside from handling the usual tasks of device sharing and file transfers, this system also offers virtual disk drive capabilities that work well, and it can even provide such unique features as IBM 3270 access and automated tape backup. Its maximum speed of 115,200 bits per second gives it excellent throughput performance for large networks. However, its flexibility does not go hand-in-hand with simplicity, and installing the NetCommander's software is a detailed task.

By contrast, the 1082 MainStreet from Newbridge Networks manages to offer an impressive set of features while very nearly approximating a plug-and-play device. It comes ready to attach to both serial devices and parallel printers, and its unique autoconfiguration capabilities manage to take much of the sting out of cabling, normally the most troublesome part of installing a serial network. The software that comes with the 1082 MainStreet package is equally simple to use, and the system's demonstrated ability to adapt to different baud rates and wiring attachments makes it little trouble once it's installed. If future growth is less important than being able to take the product out of the box and use it within 10 minutes, the 1082 MainStreet should be your choice.

Honorable mention for ease of use and performance goes to the Alternet from Equinox Systems. Though this is a new product, it is a capable one, and one that is supported by a company with years of experience. It's an excellent choice for small networks.



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other PCs to the switch.) The INC-64's menu-driven configuration software then lets you name each of the ports and set up its serial communication and security parameters. If you have many identical devices or workstations to set up, you can save time by copying any or all of the setup parameters to other ports.

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The INC-64 comes into its own when called upon to tie together users on one or two floors in an office building.

UTILITIES

EasyLAN, the PC-to-PC file sharing software that comes with the INC-64, caused us some difficulty. Its handshaking protocols required considerable experimentation to achieve a satisfactory cabling solution with the nine-pin RS-232 interface.

The system's e-mail feature lets you send messages or transfer data to any or all ports. You can display a list of messages and give the source, time, and length of each using the Read Mail command. The INC-64 system's Broadcast option lets you send a message of up to 16K to one or more ports.

The INC-64 is not designed for a one- or two-room office. It comes into its own when called upon to tie together users on one or two floors in an office building or in one or two buildings on a campus. But the newness of the system is a detraction—at the time of our evaluation, it had no parallel connection or print spooling capabilities, and the system could really use a performance boost. ■

Mike Byrd holds master's degrees in engineering (Purdue) and computer sciences (Southern Methodist University). A fighter pilot for the U.S. Air Force, he is also a division chief in a branch of the federal government that develops sophisticated electronic systems. M. Keith Thompson is the inventor of the AT TurboSwitch and the founder and CEO of Megahertz Corp. He has worked as a developer and consultant since the first Altair. Randol Tigrett is project leader at PC LAN Labs.

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by
Tony Rizzo and
Richard Hale Shaw

Lab Notes

If you were ordering a new computer today, should you specify that it come with DOS or with OS/2?

A year ago that question would have been silly. Today, however, OS/2 is no longer an operating system in search of an application. With *Paradox*, *WordPerfect 5.0*, *Lotus 1-2-3*, and *Logicomm*, you already have the big four office essentials: database, word processor, spreadsheet program, and communications software. And as each new OS/2 application comes out, the time when OS/2 will become a genuinely live option draws that much nearer.

The trend points to OS/2 viability in the foreseeable future, then, even if the breakout point has not been reached. Indeed, the problem facing most users is less *when* than *what:* they don't yet know quite what it is they'll be getting with OS/2. What are the hands-on meanings of those buzzwords "multitasking" and "graphical user interface"? That's where this article comes in.

We're going to present you with a scenario and a script. The scenario, in brief, assumes you're buying a computer for OS/2. After going through a number of *PC Magazine* articles (of course), you've rightly decided that an 80286 or 80386 machine is the way to go. You've found a good deal, with a VGA card and monitor (after all, that *is* the new standard) and a hefty 60- or 80MB hard disk. You've heard enough about OS/2 to know that you'll need a lot of RAM, so you've added 4MB. And, of course, you've included a mouse to take full advantage of the new graphical interface.

On the software side, we'll suppose that developers really will take advantage of the powerful programming features OS/2 provides, making the OS/2 versions of familiar software clearly better than their predecessors. Initially, of course, some applications will run only *in* full-screen text mode. Other applications—in time, probably all—will run under the Presentation Manager in OS/2, Version 1.1, which adds the graphical interface to the multitasking capabilities of the kernel. For practical purposes, the strictly character-based OS/2, Version 1.0, is now obsolete.

OS/2—A NEW PERSPECTIVE: Viewing OS/2 as an end-user application for managing your system is key to a successful upgrade.

What is OS/2, really? It's an environment—somewhat more expensive than the old DOS environment—in which you "manage" your computer system. Better still, let's call it an end-user "application" for managing your computer system. It may seem a little odd to describe an operating system as an end-user application, but as far as the end user is concerned that's all it actually is.

To see how this description applies, let's turn to our script and take you through a hands-on tour of OS/2. If you're in front of a machine such as we've described and you have the OS/2 1.1 package in front of you, you can actually use the Lab Notes as a script to try out the environment. This is the best way to learn what OS/2 is capable of doing, what multitasking really is, and what the talk about a graphical interface is all about.

During the tour, you'll quickly install OS/2 (it's easy), boot it up, and run some programs with it. You'll use its windowing system and facilities, learn how to use the on-line help system, access the OS/2 text-based command line, and write OS/2 batch files. You'll see how to add programs to OS/2's program starter and you'll even use—albeit briefly—the DOS compatibility environment. Finally, you will be able to install and run Borland's *SideKick for Presentation Manager*, the first Presentation Manager port of a classic DOS application. There isn't a whole lot that can go wrong, unless you issue a DEL *.* command—but that's something you should already know about!

MOUSE BASICS

While OS/2 can be run from the keyboard, we'll assume here that you have a mouse available and will use it for most operations. In a graphical environment a mouse makes infinitely more sense. So let's take a moment to become more familiar with some basic mouse concepts. (You can skip this section if you're already comfortable with using a mouse.)

- The movable arrow on the screen is called a *mouse pointer*.
- The push buttons on a mouse are simply called buttons. In OS/2, the left mouse button is used for selecting most items on the screen. (If you're left-handed, you can change the select function to the right button.)
- To select an item with the mouse, move the mouse pointer to the item on-screen, then press and release the mouse button. This procedure is also known as *clicking* on an item.
- *Double clicking* on an item means pressing and releasing the mouse button twice in rapid succession. The allowable interval between mouse clicks before the system interprets them as different events can be adjusted.
- To *drag* an item across the screen, move the pointer to the item, then press and hold the mouse button down. As long as the button remains depressed, moving the mouse pointer around the screen will pull the selected item with it.

We'll worry later about niceties such as adjusting the click rate and switching the mouse buttons around.

Lab Notes

INSTALLATION

OS/2 is easy to install, but you should be sure to read this section through to the end before you start. Then, with your OS/2 installation disk and your system disks in hand, all you do is insert the installation disk in drive A:, turn on your machine, and follow the screen instructions for inserting the disks.

Most OS/2 files are provided in a compressed format, so you don't COPY *.* to your hard disk. The installation process, for the most part, consists of setting up certain default directories and copying and expanding files onto your hard disk from the OS/2 system disks. The entire process should take about 20 minutes.

Do be careful to note that the OS/2 installation process will *replace* any version of DOS you have on your hard disk. The installation will not change any other files on your disk. Because your old files are left intact, you can maintain your old DOS system simply by creating a bootable DOS floppy and copying your CONFIG.SYS and AUTOEXEC.BAT files to it. When you want to bring up DOS, just boot from the floppy and your old system will be ready to go. [*Note: For readers who insist on working the other way around, Charles Petzold showed how to create an OS/2 boot-up floppy in his Environments column in the April 25, 1989, issue.—Ed.*]

Note too that if your machine is new and DOS is not already installed, you should consider whether you will ever need to go entirely back to DOS. (You can usually count on one of your less progressive friends or coworkers coming by to show you a DOS-based application.) If you will, make sure to install DOS first, then install OS/2 on top of it. The reason for this is that DOS can't use OS/2's hard disk partitions, but OS/2 can use those created by DOS. And, of course you'll also need to create a DOS boot disk, as explained above.

As with DOS, you can fine-tune OS/2's boot-up configuration by making entries in a CONFIG.SYS file. Under OS/2, in fact, having a CONFIG.SYS file has become mandatory. The installation program creates it and makes a number of default entries. In addition, the Presentation Manager uses a file called OS2.INI to set some of its configuration parameters. This is discussed in greater detail in the sidebar "Configuring OS/2 and Presentation Manager."

STARTING OUT

When you boot up OS/2, it's ready to go as soon as the Start Programs window and mouse pointer appear. Shown in Figure 1, this window is the preferred place from which to run OS/2 programs.

The objects at the bottom of the screen are *icons*, which always represent programs that are loaded and running but not currently displayed in a window. The icons on the left in Figure 1 represent the DOS compatibility environment and the OS/2 print spooler, respectively; the one on the right is for the Task Manager.

GETTING HELP

The Start Programs menu reveals that you can access OS/2's on-line help facility by pressing the F1 key or by moving the mouse pointer and clicking on the word Help.

Once you select Help, OS/2 will briefly change the mouse pointer to an hourglass

CONFIGURING OS/2 AND PRESENTATION MANAGER

by Richard Hale Shaw

Under DOS, you use the CONFIG.SYS file to specify system settings and to load device drivers. You can also use it to specify an alternative command interpreter. CONFIG.SYS also plays a similar but somewhat more important role under OS/2.

If you study the listing in Figure A, some of the commands in the OS/2 CONFIG.SYS file should be familiar. You'll find that BREAK, FCBS, and SHELL are still available and are used by the DOS compatibility session. Other entries, such as the DEVICE statements, are used both by the DOS session and by OS/2 to load device drivers. While both OS/2 and DOS sessions use the BUFFERS statement, the old DOS FILES statement has disappeared. (The DOS session relies on OS/2 to service file handling requests.)

Some CONFIG.SYS commands are familiar in other ways. Under DOS, for example, you can use the SET com-

CONFIG.SYS — **COMPLETE LISTING**

```
PROTSHELL=C:\OS2\PMSHELL.EXE C:\OS2\OS2.INI C:\OS2\CMD.EXE
SET PATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\INSTALL;C:\;
SET DPATH=C:\OS2;C:\OS2\SYSTEM;C:\OS2\INSTALL;C:\;
LIBPATH=C:\OS2\DLL;C:\;
SET COMSPEC=C:\OS2\CMD.EXE
SET PROMPT=$i[$p]
BUFFERS=30
DISKCACHE=64
MAXWAIT=3
MEMMAN=SWAP,MOVE
PROTECTONLY=NO
SWAPPATH=C:\OS2\SYSTEM 512
THREADS=128
SHELL=C:\OS2\COMMAND.COM /P
BREAK=OFF
FCBS=16,8
RMSIZE=640
COUNTRY=001,C:\OS2\SYSTEM\COUNTRY.SYS
DEVICE=C:\OS2\POINTDD.SYS
DEVICE=C:\OS2\MOUSEB05.SYS
DEVICE=C:\OS2\PMDD.SYS
DEVINFO=SCR,VGA,C:\OS2\VIOTBL.DCP
DEVICE=C:\OS2\EGA.SYS
```

Figure A: When you install OS/2 on your machine, it will automatically create a CONFIG.SYS file similar to the one shown above.

icon. PM applications often display this hourglass when a program is busy and must ignore mouse and keyboard input momentarily. When the loading is complete, the mouse pointer will revert to its normal shape and the Help screen for Start Programs will appear.

OS/2 help screens are context sensitive: the text they display always relates to the window from which you selected Help. You can also bring up an index to select from other help topics.

WINDOWING BASICS

Let's take a moment here to become more familiar with using the mouse in windows. The vertical *scroll bar* (on the right side of the help window, with up and down arrows at each end) allows you to scroll through the help text. You can click on the upper arrow to move up in the text and on the lower one to move down. If you click and hold the mouse button on an arrow, the text will keep scrolling. Though none are present on this screen, similar horizontal scroll bars are often available.

The scroll bar slider represents your position in the text. You can drag the slider and scroll the text, or you can click on any scroll bar position on either side of the slider and it will jump to that point. Then the scroll bar will adjust the text accordingly.

Several pushbuttons appear at the bottom of the Help window. Their function is to allow you to escape from the help window, to view an index of help topics, or to view a help screen that explains the Presentation Manager keys. Note that the default pushbutton is the one with the highlighted border, which can be selected by simply pressing Enter.

If you take a couple of minutes, you can explore these possibilities for yourself. For now, let's return to the Start Programs window by clicking on the Esc pushbutton or by pressing the Esc key.

We are now ready to learn to use our first Presentation Manager application. Use the mouse pointer to double click on

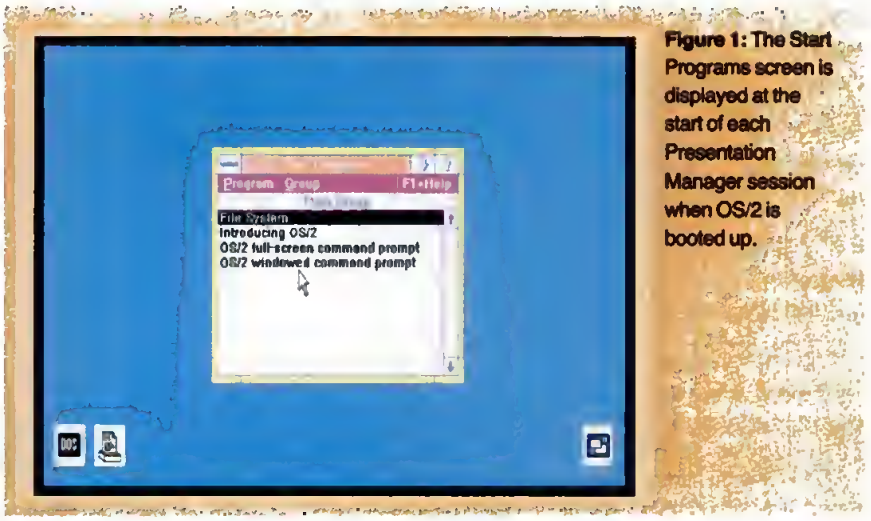

Figure 1: The Start Programs screen is displayed at the start of each Presentation Manager session when OS/2 is booted up.

mand either in batch files or from the command line to modify environment variables (PATH, PROMPT, and others). You can still use SET in those ways under OS/2, but when you do SET will affect only the session in which you issue the command. To create SET commands that apply to every session, you must place them in CONFIG.SYS. If you study the listing, you'll find that the installation program issues SET commands in CONFIG.SYS for PATH, DPATH, COMSPEC, and PROMPT.

DPATH is a new variable that sets up a search path for data file requests made by OS/2 programs. DPATH is OS/2's answer to the DOS APPEND command; instead of using APPEND, you must set up a DPATH variable. Programs, however, are still searched for through the traditional PATH statement.

IMPROVING PERFORMANCE

Depending on the amount of memory available in your machine, some of the new CONFIG.SYS commands may improve OS/2's performance. The RMSIZE command lets you set the memory used by the DOS session. Without this entry in CONFIG.SYS, OS/2 gives the DOS session the maximum amount of memory possible. (Because some parts of OS/2 must reside in absolute low memory, this is less than the theoretical 640K. Typically, setting RMSIZE equal to 640 will result in your DOS applications getting about 512K of memory.) Since the OS/2 installation program sets RMSIZE to 640K, that is 640K that OS/2 can't use. If you intend to use the DOS session only for small programs, you might enter RMSIZE=384, for example.

You also have the opportunity to remove the DOS session entirely. Doing so frees up the memory that would be allocated to the DOS session for your OS/2 sessions. Entering PROTECTONLY=YES will remove the DOS session. PROTECTONLY=NO will restore the DOS session. Note also the DEVICE=EGA.SYS line. This is used by the DOS session and must be removed from CONFIG.SYS when PROTECTONLY=YES is used.

As an alternative to removal, statements in the CONFIG.SYS file can simply be REM'd out. The REM statement is designed to let you place remarks or comments in CONFIG.SYS, but it also provides a convenient way to remove an unneeded statement temporarily. If EGA.SYS is present when the DOS session is not specified, for example, the boot process will report an error. This is not a serious problem—you simply hit the return key and continue on—but it's cleaner to remove it. You can also make OS/2 display the error without pausing by adding

```
PAUSEONERROR=NO to CONFIG.SYS
```

OS/2 uses the BUFFERS statement in CONFIG.SYS to allocate memory for its file handling. Each buffer takes up 512 bytes, so BUFFERS=100, for example, will absorb 50K of memory. I don't think you'll need to set it this high, but a setting of BUFFERS=50 will improve file handling across the board.

Another CONFIG.SYS entry that can improve system performance is

CONTINUES

the File System entry. The File System window will appear.

EXPLORING THE FILE SYSTEM

The File System is both easy to use and a good introduction to Presentation Manager applications. File System lets you perform all the standard file operations that you would ordinarily execute from the DOS command line. In addition, it graphically illustrates the arrangement of the files and subdirectories on your hard disk. If you don't have any previous experience with graphical interface programs, you'll find File System a refreshing change from the DOS command-line approach to file management.

When you start File System, it displays a directory tree of the drive (usually C:\) from which you booted OS/2. The Directory Tree window will remain open until you exit File System. You can click on one of the drive icons (or use Ctrl and the drive letter) to view the directory structure of another drive. If you try to access an empty floppy drive, selecting the Cancel pushbutton in the Error Message window that appears will reset Directory Tree back to drive C:.

You can use the scroll bar in the Directory Tree window to view the list of directories. Use it to find the OS2 directory, then select the directory by clicking once on OS/2. A window will open and display the files in that directory (see Figure 2).

Notice how File System uses icons to identify the types of files displayed in a directory window. File-drawer-shaped icons represent subdirectories, and rectangular icons represent executable files or programs. You can double click on a program's icon to run a program. The icons that resemble a page of paper with a corner turned down are for other files.

The File System window's Action Bar, at the top, includes several selections: File, Options, Tree, Arrange, Window, and Exit. As you select them, each will display a pull-down menu. Try selecting Options.

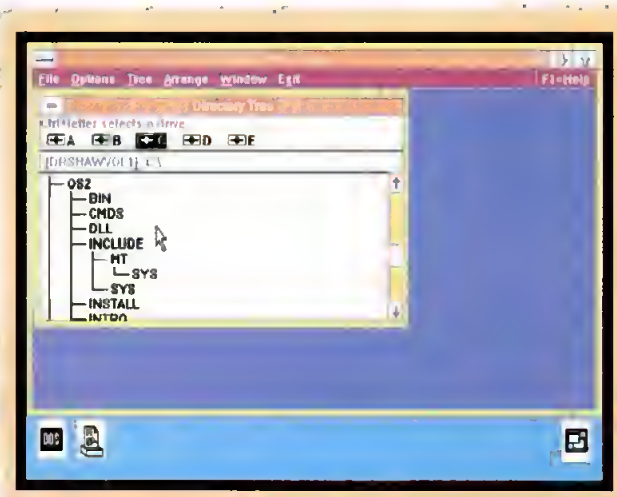

Figure 2: Directory Tree is shown here running as a window under the File System program.

("CONFIGURING OS/2" CONTINUED)

DISKCACHE. A disk cache stores frequently read data so that subsequent accesses will retrieve them from memory rather than from the disk. While the installed OS/2 default is 64K, you might want to consider at least 128K (if not 256K) if you can spare the memory—the more the better. OS/2 is a fast operating system, but the less time it needs to wait for the disk, the better.

When modifying these commands, keep in mind that OS/2 and the PM need nearly 2MB of memory to run efficiently. Add in the 640K for the DOS session and a 128K disk cache, and you have about 1.2MB left for other programs on a 4MB system.

You can fine-tune your system's memory usage by trying to run all of your most frequently used applications simultaneously. If you have enough disk space, you should be able to set up a big enough swap file so that OS/2 will be able to run most of your programs, though the system will become slower as more swapping becomes necessary.

OTHER END-USER COMMANDS

As mentioned in the main article, the LIBPATH statement sets up a path for OS/2 to find dynamic link libraries (DLLs). OS/2 applications will increasingly take advantage of DLLs in the future, so you may have to modify this statement from time to time.

Two other general commands are worth noting. The SWAPPATH command specifies the path to the system swap file. This is the file that OS/2 uses to implement its virtual memory scheme by swapping portions of memory out to a disk file. You may want to reset this command to place the swap file on another drive. The installation default is

```
SWAPPATH=C:\OS2\SYSTEM 512
```

which puts the swap file in the C:\OS2\SYSTEM directory. The number represents the amount of free space, in kilobytes, that OS/2 will leave free for other applications as the swap file grows.

The SHELL command specifies the path to the DOS session command processor. There is no reason to change this statement. However, you should realize that the COMMAND.COM specified in the SHELL command is not the same as the one on your DOS 3.3 or 4.0 disks. This is a special COMMAND.COM configured to work with OS/2. Thus, you should treat it as if it were another version of DOS. Don't change the SHELL command to point to the wrong COMMAND.COM.

Finally, the PROTSHELL command specifies the path to the OS/2 protected-mode command processor. The installation default sets this to the Presentation Manager shell and instructs it to load CMD.EXE for windowed and full-screen OS/2 prompts. You can add to it the name of a batch file that will be run by CMD.EXE whenever you start an OS/2 command prompt.

The IOPL command allows a program to request and receive additional privileges. In this way a program can

CONTINUES

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You can use the entries in this menu to alter the appearance of a directory window. For instance, if you select Display Options, the window in Figure 3 will appear. This window lets you control the content of the directory window.

The Display Options window contains several additional *display objects* commonly used in Presentation Manager programs. The object at the top of the window is an entry field, not unlike those found in DOS applications. You can use entry fields to type in information (such as a file specification or a path). Some entry fields let you type in more information than they can display, in which case they'll automatically scroll the text to the left when you reach the end of the field. If more than one field is present, use Tab and Shift-Tab to move from field to field, or place the cursor in a particular field with the mouse.

Other display objects you will see in the window are round icons called *radio buttons*. These allow you to make a single choice from a list of items. Another icon used in this window is a *check box*, which lets you designate (check off) one or more items in a list. Use the mouse to toggle the markers and check boxes on and off.

The Display Options window also lets you control the appearance and content of the directory windows. You can change the displayed file order from alphabetical to chronological, for example. The specific effect produced will depend on the sequence of your actions. If you open the Display Options window when Directory Tree is the topmost window, the options will affect all new directory windows; otherwise the options affect only the topmost directory window.

Another entry in the Options pull-down menu is Full. This entry changes the directory display window to include more-detailed information on each file or directory.

CREATING A DIRECTORY

To create a new subdirectory, select File at the Action Bar and then click on the Create directory entry in the File pull-down menu. This will bring up the Create Directory window. Since OS/2 is the currently displayed directory window, this operation will create a subdirectory in the OS/2 directory.

Type in the name of a new directory (let's call it the JUNK directory); you can then press Enter or select the Create pushbutton to create the C:\OS2\JUNK subdirectory. File System will create the new directory and place it in the Directory Tree window. To view the contents of the JUNK directory, double click on either of its entries—the one in the Directory Tree window or the one in the OS2 directory window.

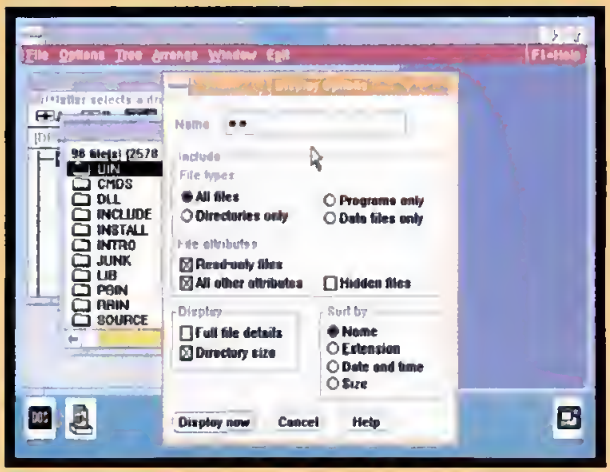

Figure 3: The various objects of the Display Options window of File System include a text entry field, check boxes, radio buttons, and pushbuttons.

("CONFIGURING OS/2" CONTINUED)

gain access to code, data, and devices from which it would ordinarily be barred. This is critical for program debuggers. In order to run Microsoft *CodeView* (and other debuggers as they become available for OS/2), you must change the default from IOPL=NO to IOPL=YES. Alternatively, you can selectively give programs this privilege by specifying a statement such as IOPL=CVP.EXE.

You probably won't have to change the MAXWAIT, MEMMAN, and PRIORITY commands. The first controls the OS/2 task scheduler, the second toggles virtual memory swapping, and the third influences OS/2's ability to set task priorities.

TIMESLICE lets you control the time that OS/2 uses to schedule the independent parts of a process, which are known as *threads*. The THREADS command lets you set the maximum number of threads available in the system. You can allot up to 255, but 64 to 128 should be more than sufficient most of the time.

THE OS2.INI FILE

The OS/2 installation program creates a file called OS2.INI when you install OS/2. The PM uses this file to store system initialization and configuration information. A PM application also uses OS2.INI to store configuration information unique to that application.

Control Panel, for instance, stores virtually all its settings in OS2.INI (see the discussion of Control Panel in the main text). This includes the system color preferences, mouse preferences, country preferences (including date, time, and currency formats), installed fonts, and printer drivers. Indeed, you can think of Control Panel as a high-level OS2.INI editor.

Various other parts of the Presentation Manager access OS2.INI, as well. When OS/2 boots up, for example, Task Manager checks OS2.INI for font filenames. Then it can load fonts and make them available for all applications. The Presentation Manager procedures for creating and manipulating various window objects (such as the title bar, menus, and pushbuttons) make use of the color preferences stored in OS2.INI. In addition, File System uses it to hold the date and time format used in displaying file information.

Finally, OS2.INI is important for printing. Application programs can access OS2.INI to determine your default printer, the associated printer port, and the name of the printer device driver. ■

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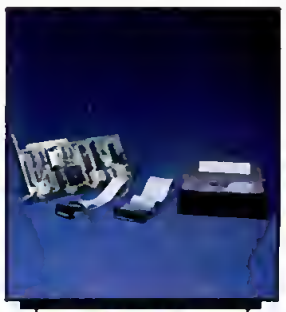

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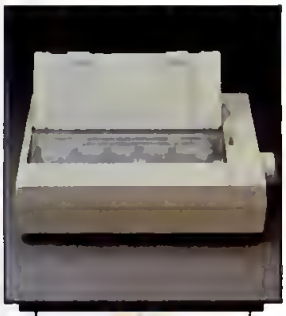

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You can override the default C:\OS2 path to the JUNK subdirectory by typing in the full path to another location. Further, you can create several directories at the same time by typing in the names of the directories separated by blanks.

To get a better look at JUNK and its parent directory, OS2, let's move the JUNK directory window to the right. Move the pointer to the title of the window (called the Title Bar). Press the mouse button and, holding it down, drag the window to the right. Use the same method to move the OS2 directory window to the left.

By clicking the mouse pointer anywhere within the exposed portion of a window, you can bring that window to the top of an overlapping group of windows. This process is known as *activating* a window. The active window is highlighted and receives keyboard and mouse input. You can swing through the directory windows by repeatedly pressing Ctrl-F6, or you can use the Window pull-down menu to choose from a list of open directory windows.

With both the OS2 and JUNK directory windows open, you can copy files from one to the other. Select APPEND.EXE in the OS2 directory window by clicking on it once. With the mouse button held down, drag the mouse pointer to the JUNK window. Note that in the process File System has changed the mouse pointer to a file icon. Release the mouse button when the pointer is in the JUNK window, and File System will copy APPEND.EXE from OS2 to OS2\JUNK.

You can also copy multiple files in one fell swoop. Hold down the Ctrl key while you click on the entries you want, and the whole group will be highlighted. Release Ctrl and click on one of the entries. Drag the pointer to the other window (the pointer will change to a multifile icon). When you release the button, the files will be copied to the other window. Use this to copy entire subdirectories, as well.

You can also move files instead of copying them. The difference is that you hold down the Alt key while dragging the pointer from one window to another. When the mouse pointer changes to a file icon during a move, the icons in the source window disappear. You can even move files across drives. (When moving files from one drive to another, File System first copies the files to the destination drive and then deletes them from the source.) You can use the Copy or Move entries directly from the File pull-down menu, but the visual approach we've just described is simpler and more intuitive.

SELECTING FILES

You don't have to scroll through the window to locate and select files. If you simply press the first letter of the filename, File System will jump to the first matching entry. Similarly, you can use spacebar, instead of the mouse, to select files. If you choose an unselected name after you release the Ctrl key, previously selected names will be deselected. And you can select the Undo entry in the File pull-down menu (or hit F9) to reverse an accidental selection or deselection.

Since OS/2's multitasking environment allows background programs to create, delete, and copy files, a background process might change a directory without your knowledge. You can use F5 or the Refresh entry in the Window pull-down menu at any time to update a directory display.

File System also lets you associate file extensions with programs. Suppose, for example, that you decide to associate the .TXT file extension with your word processor. Every time you select a file with that extension, File System will bring up your word processor and give it the name of the selected file, just as if you had typed it on the command line.

You can set up such associations by using the Associate entry in the File pull-down menu. File System will let you enter an extension to associate with a program or a program name to associate with a file.

That's enough information about File System to get you started. There are many more features to explore, but since you can do that on your own, we'll leave File System for now. We won't actually close File System down, however—you never know when you'll need to use it again. We'll iconize it instead. One way to do this is by clicking on the system menu and selecting the Minimize option. When you do so, note that an appropriately designed icon appears at the bottom of the screen.

By now you're probably starting to feel comfortable with PM's windowing interface and the mouse. Introducing OS/2, found on the Start Programs window, will give you a good deal more information about the Start Programs, Task Manager, File System, and Help windows. It also includes a Presentation Manager simulator

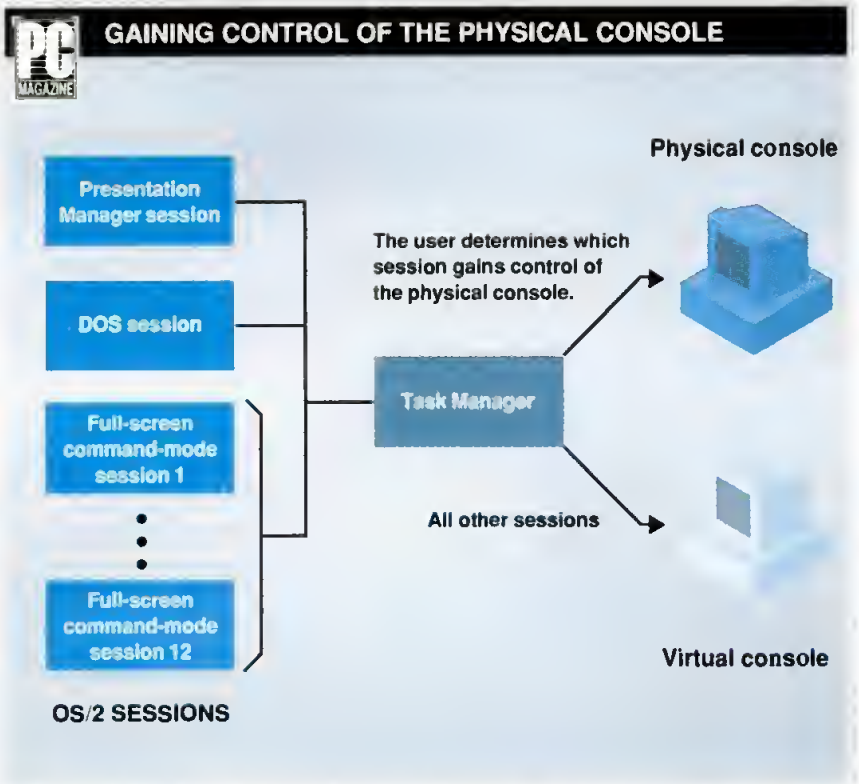

Figure 4: The user can cycle through each OS/2 session by hitting Alt-Esc. Only one session can have control of the physical console at any given time.

that will help you learn to use the features and functions of the system.

FULL-SCREEN COMMAND LINE

There are times when you don't *want* all the useful features and visual interaction built into the Presentation Manager. If all you need to do is bring up your word processor with a filename you already know, a graphical interface can represent an annoying degree of overkill. Thus, OS/2 still offers you a traditional command-line interface for working with programs and files. Just click on the Full-Screen Command Line selection in the Start Programs window and you'll have a screen that almost looks like good old DOS.

The screen is produced by CMD.EXE, which is basically the OS/2 equivalent of the DOS COMMAND.COM. OS/2 introduces a few subtle differences, however, so we must pause for a moment to go over some new terminology.

SESSIONS AND SCREEN GROUPS

Even though OS/2 allows a number of programs to run simultaneously, there is only one physical monitor, keyboard, and screen attached to a given system. Let's call these three devices, collectively, the physical console. Obviously, only one application can communicate with the physical console at any given instant, or there would be chaos. OS/2 juggles the needs of all the applications running under it in such a way that only one application—selected by the user—"owns" the physical console at any given time. All other applications communicate with a virtual console.

Each application runs in its own *screen group*. It's called a group because, in general, an application involves more than one underlying process, and each process may be able to communicate with the console. More commonly, a screen group is referred to as a *session*. When a user switches between different applications (or sessions), what he is actually doing is giving a particular session ownership of the physical console. When an application has control of the physical console, it is said to be operating in the *foreground*. All other running applications are said to be running in the *background*. These relationships are shown in Figure 4.

OS/2 lets you create as many as 12 full-screen character-mode (that is, DOS-like) sessions, one PM session, and the DOS session. There are other types of OS/2 sessions, but we won't go into them here.

Within its own single session, the Presentation Manager can simultaneously run up to 16 PM programs and as many as 16 *windowed text sessions*. (We'll get to these shortly.) File System, for instance, is a PM program, and so runs in the Presentation Manager's session (Figure 5). Under the Presentation Manager, more than one running PM application and/or text window can share the video display, but only one application can have the *focus* (the ability to interact with the user through the keyboard and mouse) at any one time.

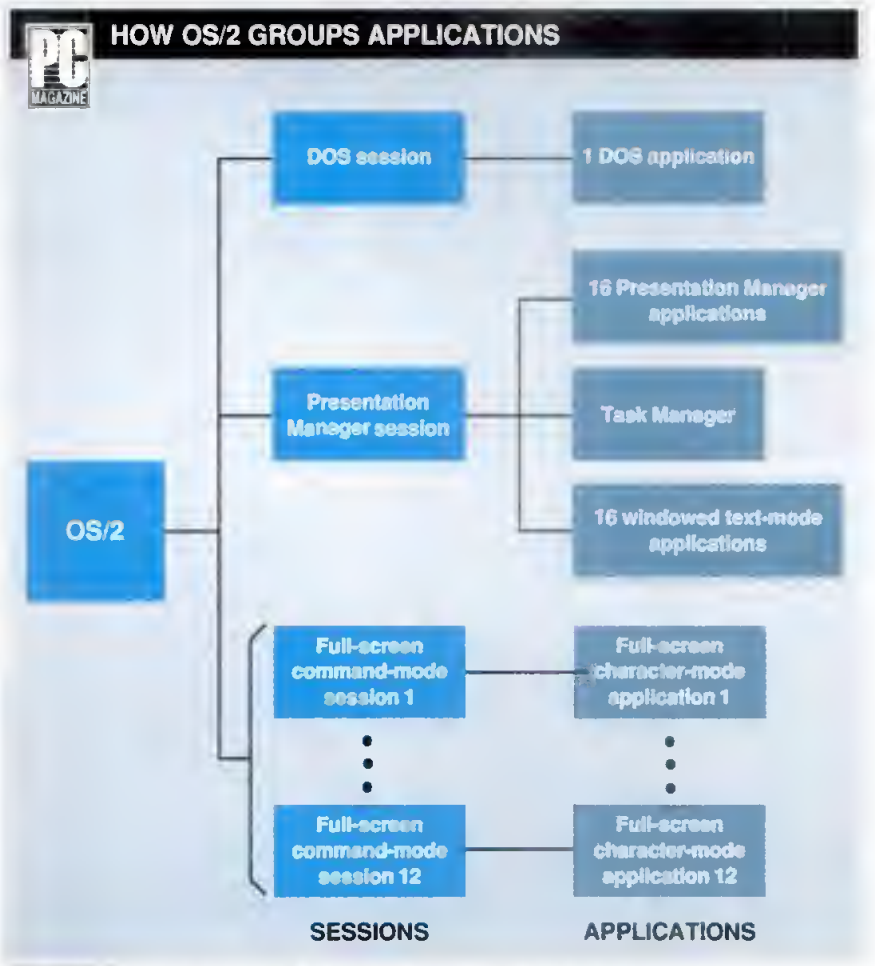

Figure 5: OS/2, Version 1.0, can simultaneously multitask 46 applications.

USING CMD.EXE

You can run OS/2 programs from the command line (*full screen character mode*) in exactly the same manner as you do under DOS. Most of the traditional and familiar DOS commands are available here, and OS/2 provides some new ones. Enter

```
DIR a:*.bat c:*.com config.*
```

and you'll see that the OS/2 version of the DIR command has been enhanced to accept multiple arguments. This is also true for DEL, TYPE, MD/MKDIR, and RD/RMDIR.

The CMD.EXE interface is very similar to that of the DOS environment, but more functionality has been built into it. For example, there are new command-line operators that let you run multiple or selected commands. Enter

```
DIR test.exe && COPY test.exe \junk
```

and if the command to the left of && is successful (that is, if test.exe exists), then the command to the right of && (in this case, the copy command) will be executed. The && is called the AND command.

Similarly, enter

```
DIR c:\test.exe || copy \junk
\test.exe c:\
```

and if the first command is successful, the second will be ignored. If the first command is not successful (if test.exe does not

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exist), the second command will be executed. The | | is called the OR command.

Now enter

```
DIR test.exe & COPY test.exe
 \junk\test1.exe & cls
```

and each command will be executed in the order given. The ampersand (&) is called the *command separator*.

There are other operators, but this should give you an idea of the functionality that has been added to CMD.EXE.

DETACH AND START

One of the new OS/2 commands is Detach. This command lets you start programs in a special session that runs *only* in the background—you'll never see it and you can't interact with it. Of course, that means that you should only use it on programs that don't need to print messages on the screen or get input from the keyboard.

For instance, you can DETACH a program to sort a file (using the SORT command, for example) in the background. Another use of DETACH might be for running a script-driven communications program that downloads files in the background. The advantage of using DETACH is that it doesn't use up a session. The disadvantage is that you won't know when the program is done or how it's doing—unless it uses one of OS/2's special facilities to keep you posted.

Another new OS/2 command is START. It lets you start a new session from the command line of another session or from a batch file. By using START, you don't have to return to the Start Programs window to begin a new session. You can also use START to run programs when you first boot OS/2.

OS/2 BATCH FILES

OS/2 provides a batch facility similar to that available under DOS, except that OS/2 batch files use a .CMD extension instead of .BAT. This allows you to create OS/2 versions of DOS batch files that can take advantage of OS/2's added functionality.

SETLOCAL and ENDLOCAL are two new OS/2 batch file commands. SETLOCAL will preserve the session's current drive, directory, and environment settings at the time that you execute it. You can use ENDLOCAL later in the batch file to restore these settings; this saves having to write batch file lines to do the same thing. For instance, in a DOS batch file you might have to use the following environment strings to save the drive and directory information:

```
set drive=C:
set dir=\JUNK




%drive%
cd %dir%
```

Under OS/2, the batch file simply becomes

```
SETLOCAL




ENDLOCAL
```

These commands *localize* changes made to the drive, the directory, and the environment strings. They are not unlike the PUSHDIR and POPDIR utilities presented in the Programing/Utilities section of the May 27, 1986, issue.

STARTUP.CMD is OS/2's equivalent of DOS's AUTOEXEC.BAT. You create this special batch file yourself, just as you had to create AUTOEXEC.BAT for DOS. OS/2 looks for STARTUP.CMD in the root directory of the C: drive. You can use the START command in STARTUP .CMD to start various programs in their own sessions when you boot OS/2. By the time the Start Programs menu appears, these programs will already be running. The effect is similar to running TSR programs from AUTOEXEC.BAT under DOS, except that these are full, working applications, each running in its own independent environment.

RETURNING TO THE PM

Now let's return from the full-screen command prompt to the Start Programs window. There are several ways to get there, but you can't use a mouse. The easiest way is simply to close this OS/2 session by typing EXIT at the OS/2 command prompt. The full-screen window will close and you'll be back in the PM session with the Start Programs window. You can also use Alt-Esc to switch from one session to the next or to switch through the programs running in Presentation Manager windows. You also can use Ctrl-Esc to bring up the Task Manager, which automatically takes you back to the PM session.

PM'S WINDOWED TEXT SESSIONS

OS/2 lets you run CMD.EXE in a Presentation Manager text window as well as at the full-screen command prompt. To do this, you select OS/2 Windowed Command Prompt from the Start Programs window. OS/2 will open a new window with its prompt inside.

This session is just like the full-screen session except that everything is displayed inside a window. Try DIR and some of the other commands here. You may need to use the scroll bars on the window to see some of the output.

OS/2 has a batch facility similar to that available under DOS. The files have a .CMD extension.

MORE WINDOW BASICS

There are several different ways to change a window's size. First, you can select a window's Maximize icon, which expands a window to fill the entire screen. This icon, found in the upper right corner of the window, looks like a large up arrow. You can use the Restore icon (composed of two up-down arrows) to restore the window to its previous size. The Minimize icon (a down arrow) removes the window from the screen entirely, save for the icon that takes its place and joins those at the bottom left side of the screen. Remember that when you minimize a window, the program, though not visible in a window, continues to run.

You can restore a minimized program simply by double-clicking on its icon. The alternative is to click on it once, at which point a menu will pop up from the icon. If you click on the Restore entry in this menu, the program's window will be restored. The menu is nearly the same as that associated with a window's System Menu icon (the horizontal bar in the upper-left

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corner of the window). You can select this icon to access the system menu and use it as still another alternative to the steps that we've just taken.

You can also resize a window. You do this by moving the mouse pointer slowly across one of the window's borders until the pointer changes into a double-arrow icon. Then press the mouse button, drag the border in the direction you want to move it, and release the button. Alternatively, you can use the same approach to move a corner of a window and resize it diagonally.

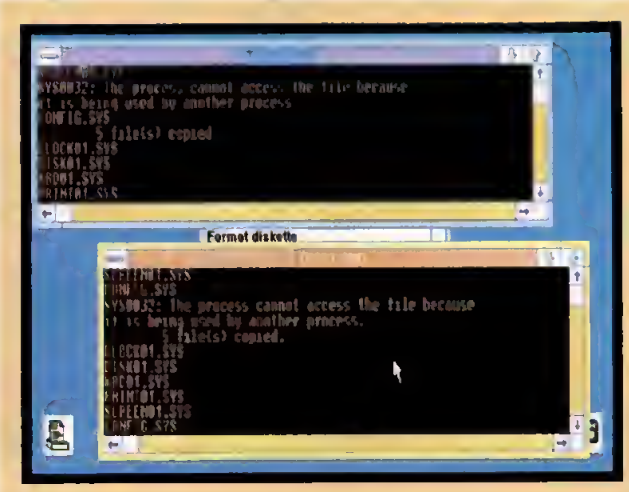

Figure 6: OS/2's multitasking capabilities are demonstrated here by running the same batch file simultaneously in two windows. The active window is always highlighted.

SIMPLE MULTITASKING

Let's use our new knowledge of windows and OS/2 batch files to explore OS/2's multitasking capabilities. To make things easy, we'll write two very simple batch files that run in different windows at the same time. You could, of course, start up some real OS/2 programs, but this little demonstration will give you a much better hands-on feel.

First, make sure that the active window is one of the command-line windows. Just hit Alt-Esc until you get to the window, or simply click on it with the mouse. Once there, make sure you're logged onto drive C: and create a dummy directory, C:\JUNK. Next, create a batch file called TEST1.CMD. To do so, simply type the following at the OS/2 command prompt, terminating all but the last line by hitting Enter:

```
COPY CON TEST1.CMD
ECHO OFF
:START
COPY *.SYS JUNK
GOTO START
^Z
```

Use the F6 function key or Ctrl-Z to create the ^Z. Now use the START command to open another session window by entering

```
START
```

Then run the TEST1 batch file in the window by typing

```
TEST1
```

This will repeatedly copy the .SYS files from the root to the JUNK directory.

Next, let's move back to the original window and run TEST1 there, as well. The screen shot in Figure 6 shows TEST1 running in two different Presentation Manager text windows.

You'll notice that the active window will run slightly faster than the other. That's because OS/2 gives the active window a slightly higher priority and more time in which to run. If both sessions try to copy the same file at the same time, the first one to access the file will lock the other one out, since the COPY command locks the file being copied. The other session will begin copying the next file. If the active window prevents the inactive session's batch file from copying too often, the inactive window will appear to run faster because it's not copying every file. You can use the mouse to jump between the windows, activating first one and then the other to even the score a bit.

Let's try one more example of multitasking batch files. Stop the batch file in the active window by pressing Ctrl-Break or Ctrl-C. Then enter the following new batch file:

```
COPY CON TEST2.CMD
ECHO OFF
:START
TIME < CR
GOTO START
^Z
```

Now create a file called CR with two blank lines in it:

```
COPY CON CR
[enter key]
[enter key]
^Z
```

First, run TEST2.CMD in the active window. The other window will still be running TEST1.CMD. You'll notice that TEST1.CMD will slow down significantly when you run TEST2.CMD in the active window. Once you activate the File's window, however, TEST1.CMD and TEST2.CMD will appear to run normally. Now run TEST2.CMD in each of the windows simultaneously. Note that, with TEST2.CMD in both windows, the active window will run normally, but the inactive window will run much more slowly. On a 25-MHz 386 machine, the copy of TEST2.CMD in the inactive window will print the time about every 27 seconds, but the time will vary depending on the machine you're using.

This has given you a good visual example of multitasking. Most well-designed OS/2 programs will run more efficiently than CMD.EXE's batch processor. You'll find that there is typically far less contention between programs and that most will run quickly in either the foreground or the background.

One other thing to note is that you can easily switch to full-screen mode, log on to the appropriate drive, and set these batch files running from there as well. You can switch from session to session and continue to see them execute.

You can leave the windows open and let the batch files run if you wish; they won't interfere with what you're doing. If they become a distraction, you can always minimize them. If you want to terminate these sessions, however, you can press Ctrl-Break to stop the batch file and then EXIT. Or, you can select Close from the System Menu. However you do it, let's return to the Start Programs window.

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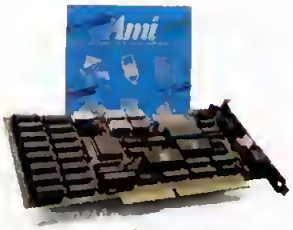

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THE START PROGRAMS WINDOW

To learn how to add programs to OS/2, let's add the TEST1.CMD batch file to Start Programs. Select the Add entry in the Program pull-down menu in Start Programs. A window like the one shown in Figure 7 will appear. Enter TEST1 for the program title, C:\OS2\CMD.EXE for the path and filename, /C TEST1.CMD for the parameters, and C:\ for the working directory. You can use the Enter or Tab key to skip to the next field and Shift-Tab to back up a field. Then click on the Add pushbutton. Start Programs will place the new entry in the window. Double click on the entry and a window will open with the batch file running in it.

As you can see, it's very easy to add a new program to Start Programs. TEST1.CMD is a batch file, so the instructions are slightly different for ordinary programs. For other programs, you would enter the program's name in the path/filename field and leave the parameters field empty (unless the program calls for parameters). If you want OS/2 to prompt you for parameters when you run the program, just place a question mark (?) in the parameters field. Note that the program title can be up to 60 characters long and that you cannot add DOS programs to the Start Programs window.

The name you enter in the working directory field becomes the current directory for the program. If OS/2 can't find the working directory, it will use the root of the boot disk (usually drive C:). Once you've added a program, you may want to change this information. To do so, simply select Change from the Program pull-down menu in the Start Programs window. The process is pretty straightforward from there.

The Start Programs window is subdivided into groups of programs. By default, Start Programs displays the Main Group. You can change groups, however, by selecting a group name from the Group pull-down menu. The same menu lets you add, delete, or rename groups. The Utilities group, for example, includes several useful OS/2 programs, among them a simple OS/2 editor.

Use Task Manager to switch to a program, rearrange program windows, and shut down a program or the entire system.

CONTROL PANEL

Now let's take a closer look at Control Panel, which allows you to modify parts of the Presentation Manager interface. To change the system date and time, click on the digit you want to change in either box. A small scroll bar will appear, and you can use it to increment or decrement the selected digit. You also can change the cursor blink rate (use the horizontal scroll bar) and the mouse double-click rate in this window. The latter adjusts the interval between double-clicks of the mouse button. If you want the mouse to respond more quickly to double-clicks, move the scroll bar slider to the right. You can test the result by double-clicking on TEST in the displayed box. The box will reverse its color whenever it receives a double-click.

Control Panel includes several pull-downs menus, but we'll concentrate on only the highlights here. The Preferences menu lets you adjust the settings for window colors and border width and lets you decide whether you want a warning beep to sound when system messages appear. There is also an entry that lets you swap the left and right mouse buttons, as well as one for modifying the country- specific information. You can also change the window colors for all the various component parts of a PM window through the Screen Colors window.

Within Control Panel there are also menus that allow you to modify the parameters for the communications port, the printer, and the print spooler. The printer options allow you to specify more than one logical printer and which printer port to use with it. The Spooler queues and Queue connections entries allow you to specify the names of different logical printer queues and which print spooler program manages which queue. There are further options here for you to explore.

You should, however, click on the OS/2 System Editor and take a brief look at it. It's by no means the best OS/2 editor around, but it does come with the system and it's certainly better than DOS's EDLIN! We won't go into the actual workings of the editor, but note that the editor is running in a full-screen text window.

Let's leave the Editor running and move to Task Manager by pressing Ctrl-Esc. It's worth noting that you can use this keystroke from anywhere in the system to summon Task Manager. You'll see that an icon appears at the bottom of the screen with "OS/2" in it. This is the standard icon for a full-screen command-line window that is open and fully operational.

TASK MANAGER

Task Manager lists the programs that are running on the system. You can use it to switch to a program, rearrange the program windows, shut down a program, or shut down the entire system. The Task Manager window is shown in Figure 8.

Figure 7: New programs and their initial parameters are added to the Start Programs menu by using the Add Program pull-down menu option.

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Lab Notes

You don't have to use the Task menu to switch or close windows; it's strictly a convenience. The Arrange pull-down menu organizes all the windows that are open on the PM desktop and gives you options to tile or cascade windows. The Shutdown pull-down menu initiates a shutdown of the entire system. If any programs are open and manipulating data, Task Manager will report this information to you and give you the chance to not close the application in question.

Figure 8: Task Manager will switch between and safely shut down programs and will warn you when data is still being processed. OS/2 System Editor is far easier to use than DOS EDLIN.

THE DOS COMPATIBILITY SESSION

Now that you've seen how nicely OS/2 allows you to control your system, you may have lost some of your interest in the DOS compatibility session. In fact, if you take our advice and simply boot DOS from a floppy disk when you require it, you won't even need to have a DOS session under OS/2. Eliminating that session will free up additional memory. But since it's available at this point, let's take a look at it.

The DOS session runs a special version of DOS. It will run many but not all DOS programs, and it will run them only when you bring this session into the foreground. (Programs that run in the DOS compatibility session will not run in the background.) OS/2 programs will continue to run in the background while the DOS session is in the foreground, however.

The main restriction involved in using the DOS session is that you can't run DOS programs that significantly alter the DOS environment. Many programs that make extensive use of DOS interrupts (such as TSR programs and communications programs), that write directly to the screen, or that are timing-dependent, may present problems. There's just no good way to find out except to try them.

To bring up the DOS session, double-click on the DOS command prompt. Now, you're on your own. You can't EXIT from the DOS box, but you can hit Ctrl-Esc to return to the Task Manager.

INSTALLING SIDEKICK FOR PM

As a final test, let's install a new PM application, *SideKick for Presentation Manager* (hereafter, *SKPM*). This program deserves to be considered a classic PM application because of its extensive use of the interface. IBM will send you a free copy of *SKPM* when you register your copy of OS/2 1.1, and it's well worth getting. We won't explore the program itself here, but will confine our attention to the installation process.

SKPM is as easy to install as OS/2 itself. You simply open either a windowed or full-screen command prompt, insert the first installation disk in a floppy disk drive, change to that drive, and enter

```
SETUP A: C:
```

The installation program will prompt you through a couple of screens, and the installation will proceed. When the installation is done, note that there is now a SideKick for PM group in the Start Programs window (see Figure 9).

When SETUP is done, it will instruct you to reboot your system. The reason for rebooting is that the *SKPM* setup program adds an entry to the OS/2 CONFIG.SYS file that tells OS/2 where to look for certain files. This is similar to updating a path statement in an AUTOEXEC.BAT file or modifying your DOS CONFIG.SYS file: it doesn't take effect until the next reboot of the system. Thus, to activate the entry *SKPM*'s setup program has made in the OS/2 CONFIG.SYS file, the easiest thing to do is simply to have the user reboot the system.

There is a more technical reason for rebooting, as well. (You can skip to the next section if technical details don't interest you). *SKPM* uses OS/2 dynamic link libraries (DLLs), which allow more than one program to use the same code at the same time. They also allow a vendor to change the code used by several programs without recompiling the programs themselves. A software vendor can put this code into a DLL, where it can be used by several programs. The DLL is only loaded

Figure 9: As part of its installation process, *SideKick for Presentation Manager* adds itself to the Start Programs menu.

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into memory one time, regardless of how many programs use it at the same time. If other programs access the code, OS/2 will have them use the copy of the code that it previously loaded.

OS/2 typically stores DLLs in C:\OS2\DLL, but you can use a variable, LIBPATH, in your CONFIG.SYS file to maintain additional directories that contain DLLs. When you install *SKPM*, the SETUP program modifies CONFIG.SYS and adds the C:\SIDEKICK directory to the LIBPATH entry (the drive letter will depend on where you installed *SKPM*). When you run *SKPM*, it will use the appropriate DLLs (*SKPM* requires four of them). However, this new addition to LIBPATH will not have any effect until you reboot OS/2. Alternatively, you could just copy the four DLLs in the SIDEKICK directory to \OS2\DLL, which OS/2 already knows about, saving yourself a reboot.

If a program can't save its data, the Task Manager will warn you.

REBOOTING OS/2

Use Ctrl-Esc to bring up Task Manager, and select Shutdown. Task Manager will ask for confirmation that you want to shut the system down. Then it will attempt to shut down each program that is running and close the program's files, if possible. It will not interrupt the Start Programs window, Spooler Manager, the DOS session, or itself. Note that during this process, it will not let you access other windows with the keyboard or the mouse.

If a program can't save its data, the Task Manager will warn you and ask if you want to proceed. When Task Manager has finished terminating programs, it will display a final message telling you that you may now shut down. When you see this message, reboot.

You already know how to start each of the four modules from the Start Programs window, and when the window appears, select the SideKick for PM group. We'll leave you to explore the program on your own. You'll find that it is easy and intuitive to use. In fact, you will probably find it addictive.

SUMMARY

Well, we've reached the end of our test run. Is OS/2 an operating system or an end-user application? Perhaps the more important question would be, "Does OS/2 offer substantially increased utility and functionality to me as an end user?" We emphatically think it will offer those advantages. Will you agree? Our hope is that you will now be able to give an informed answer to that question. ■

Tony Rizzo is the senior technical editor of PC Magazine. *Richard Hale Shaw is a contributing editor of* PC Magazine.

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*George Walther, *Phone Power* (New York: Berkley Books, 1986)

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- BIOS ROM based setup and system diagnostics
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by
Michael J. Mefford

Utilities

CONVERT.COM: Here's the magic link between ASCII, hex, decimal, octal, and binary numbers.

If people had flippers instead of fingers, we'd all have learned to count by twos. It would be as natural for us as for our computers to think of 9 as 1001. But since we learned to count by tens instead—and our computers haven't—when we want to control our machines directly, we must translate our numbers into theirs.

CONVERT does just that, giving you instant numeric and ASCII equivalents in decimal, octal, hexadecimal, and binary formats. You're most likely to need CONVERT when you buy a new printer, modem, or EGA monitor and have to translate the required escape sequences and setup strings. Your word processor, for example, may discuss printer commands in terms of decimal-based ASCII characters, while your printer needs to see those same characters in hex. Or, when you want to play with color-setting EGA programs, you may need to enter the EGA register values in octal notation. And often the only way to understand how a programming "shift mask" works is to look at its numbers in binary.

You can download a ready-to-run copy of CONVERT.COM from PC MagNet, as explained in the sidebar "CONVERT by Modem." CONVERT.ASM, the source code listing, and CONVERT.BAS, a BASIC program that will produce CONVERT.COM when you run it, are both printed here and are also available via PC MagNet.

The full syntax for using CONVERT is

```
CONVERT number[-number][base] |
 "character(s)"
```

You can give CONVERT either a single whole *number* or a range (joined by a hyphen between them) of such numbers, using any values between 0 and 65,535. Ordinary decimal input is assumed unless you indicate a different *base* by appending b (binary), o (octal), or h (hexadecimal) to the *number*(s). Alternatively, as indicated by the vertical bar in the syntax line above, you can ask CONVERT to supply the numeric value (in all four number bases) of any ASCII *character* (or two) that you enclose between double quotation marks.

For example, if you enter

```
CONVERT 65
```

the screen will display

```
65 0041h 000101o 01000001b " A"
```

These, of course, are the hexadecimal (0041h), octal (000101o), binary (01000001b), and ASCII character (A) equivalents of the decimal number 65. The same display will appear if you enter

```
CONVERT "A"
```

or

```
CONVERT 0041h
```

or any of the other equivalents.

CONVERT also lets you redirect its output to a file or to a printer, which is useful when you want to create a table of translated numbers. To make a printed table of the first 55 numbers, enter

```
CONVERT 0 - 55 > PRN
```

A file version could be created by substituting a filename for PRN. Note, however, that when you use redirection, the ASCII-character equivalent will not appear in the redirected output. Redirection only works with I/O done through DOS calls, and the CONVERT program uses the BIOS for the character output.

By working through the BIOS, CONVERT avoids the special character processing that DOS and the printer do with the low ASCII control characters. For example, an attempt to display character 7 (the bell character) through DOS would be interpreted as a command and would produce an annoying beep. Instead, CONVERT's procedure allows it to translate printer "control" characters into their numeric values. Thus, to translate Ctrl-A, just hold down the Ctrl key while typing A between double quotes. The Ctrl key will automatically appear as a caret, thus:

IN-LINE CODE

In issue 12, we introduced a new treatment of in-line code. From now on, we will tint *every other line* of code so you can easily distinguish one *complete* line of code from the next. If what should be a single-line entry on-screen is shown on two lines in the magazine, both lines will receive the same tint treatment. In addition, the number of spaces a secondary line is indented will indicate the number of spaces you should include when typing that multiple-line listing as a single-line entry on-screen. If a line is not indented, do not include any spaces.

```
;-----------------------------------------------------;
;  Convert.cmo - Converts either a number no character ;
;  to complementary radices.                          ;
;  Decimal, Hexadecimal, Octal and Binary supported.  ;
;  PC Magazine * Michael J. Mefford                   ;
;-----------------------------------------------------;
_TEXT           SEGMENT PUBLIC 'CODE'
                ASSUME  CS:_TEXT,DS:_TEXT,ES:_TEXT,SS:_TEXT
                ORG     100H
START:          JMP     MAIN

;               DATA AREA
;               ---------
SYNTAX          DB      CR,SPACE,SPACE,SPACE,CR,LF
COPYRIGHT       DB      "CONVERT 1.0 (C) 1989 Miff Communications Co.",CR,LF
PROGRAMMER      DB      "PC Magazine ",BOX," Michael J. Mefford",CR,LF,LF

                DB      "Syntax:  CONVERT number[-number][radix] | "
                DB      QUOTES,"character(s)",QUOTES,CR,LF
                DB      "radix:  b = binary, h = hexadecimal, o = octal",CR,LF
                DB      "default is decimal",LF,"$",CTRL_Z

CR              EQU     13
LF              EQU     10
CTRL_Z          EQU     26
SPACE           EQU     32
QUOTES          EQU     34
BOX             EQU     254
SPACE_CNT       EQU     5

INVALID_MSG     DB      "Invalid parameter",CR,LF
                DB      "Number range: 0 - 65535",CR,LF,"$"

RADIX_TYPE      DB      "HOB"                   ;Hex, octal, binary.
RADIX_CNT       EQU     $ - RADIX_TYPE

INPUT_CALLS     DW      DECIMAL_INPUT, HEX_INPUT, OCTAL_INPUT, BINARY_INPUT
CALLS_END       EQU     $ - 2

;               CODE AREA
;               ---------

;-----------------------------------------------------------------------;
; Capitalize the parameters so a single compare for radices can be done. ;
;-----------------------------------------------------------------------;
MAIN            PROC    NEAR
                CLD                             ;All string moves forward.
                CMP     BYTE PTR DS:[80H],0     ;Are there parameters?
                JNZ     PARSE                   ;If yes, continue.
                JMP     ERROR_EXIT              ;Else, exit with syntax message.

;-----------------------------------------------------------------------;
; Parse the parameters by looking for either carriage return, quotes, or dash. ;
;-----------------------------------------------------------------------;
PARSE:          MOV     DL,LF                   ;Print a linefeed just to first
                CALL    PRINT_CHAR              ;  to make our output look pretty.
                MOV     BX,82H                  ;Point to parameters again.
NEXT_INPUT:     MOV     BP,BX                   ;Start parameter start.
NEXT_PARSE:     LODSB                           ;Get a byte.
                CMP     AL,CR                   ;Is it carriage return?
                JZ      EVALUATE                ;If yes, done here.
                CMP     AL,QUOTES               ;Is it quotes?
                JZ      CHARACTER               ;If yes, character entry.
                CMP     AL,"-"                  ;Is it delimiting dash?
                JZ      NEXT_PARSE              ;If no, find parameter end.
                CMP     BP,82H                  ;Else, is this first dash?
                JNZ     EVALUATE                ;If no, evaluate just the two.
                PUSH    SI                      ;Save our position.
                CALL    GET_NUMBER              ;Get the parameter.
                POP     SI                      ;Restore our position.
                PUSH    BX                      ;Save the number.
                JMP     SHORT NEXT_INPUT        ;Get second parameter.

;-----------------------------------------------------------------------;
; If quotes were detected, store up to two characters to be evaluated. ;
;-----------------------------------------------------------------------;
CHARACTER:      XOR     BX,BX                   ;Assume no characters.
                LODSB                           ;Get a byte.
                CMP     AL,CR                   ;End of parameter?
                JZ      ERROR_EXIT              ;If yes, No character; exit.
                MOV     BL,AL                   ;Else, store character.
                LODSB                           ;Get next character.
                CMP     AL,CR                   ;End of parameter?
                JZ      GOT_CHAR                ;If yes, Only one character.
                CMP     AL,QUOTES               ;Is it quotes?
                JNZ     GET_CHAR                ;If no, valid second character.
                CMP     BYTE PTR [SI],QUOTES    ;Is it followed by quotes?
                JNZ     GOT_CHAR                ;If no, not quotes in quotes.
GET_CHAR:       MOV     BH,AL                   ;Else, store second character.
                XCHG    BH,BL                   ;Swap so in right order.
GOT_CHAR:       XOR     CX,CX                   ;Zero out parameter count.
                JMP     SHORT CONVERT           ;Convert the character.

;-----------------------------------------------------;
; Find range of numbers and display the complementry radices. ;
;-----------------------------------------------------;
EVALUATE:       CALL    GET_NUMBER              ;Get the parameter.
                XOR     CX,CX                   ;Assume only one parameter.
                CMP     BP,82H                  ;Where there more than one?
                JZ      CONVERT                 ;If no, convert just the one.
                POP     CX                      ;Else, retrieve the first one.
                CMP     CB,BX                   ;Is it the larger of the two?
                JA      FIND_RANGE              ;If yes, find range.
                XCHG    BX,CX                   ;Else, swap numbers.
FIND_RANGE:     SUB     CX,BX                   ;Find difference.

CONVERT:        INC     CX                      ;Increment by One for "thru".
                MOV     DI,BX                   ;Save number to be converted.
OUTPUT:         PUSH    CX                      ;Save count to be converted.
                CALL    DECIMAL_OUTPUT          ;Display decimal, hexadecimal,
                CALL    SPACING                 ; octal and binary equivelents
                CALL    HEX_OUTPUT              ; with spaces in between.
                CALL    SPACING
                CALL    OCTAL_OUTPUT
                CALL    SPACING
                CALL    BINARY_OUTPUT
                CALL    SPACING
                CALL    ASCII_OUTPUT
                MOV     DL,CR
                CALL    PRINT_CHAR
                MOV     DL,LF
                CALL    PRINT_CHAR
                INC     DI                      ;Get ready for next number.
                POP     CX                      ;Retrieve conversion count.
                LOOP    OUTPUT                  ;Do them all.
                XOR     AL,AL                   ;Exit with ErrorLevel of zero.
                JMP     SHORT EXIT

;-----------------------------------------------------------------------;
; Exit with syntax message and ErrorLevel of 1 if error, else ErrorLevel 0. ;
;-----------------------------------------------------------------------;
ERROR_EXIT:     MOV     DX,OFFSET SYNTAX        ;Display syntax.
                CALL    PRINT_STRING
                MOV     AL,1                    ;ErrorLevel one.
EXIT:           MOV     AH,4CH
                INT     21H                     ;Terminate.
MAIN            ENDP

;               ~~~~~~~~~~~~~~
;               *SUBROUTINES*
;               ~~~~~~~~~~~~~~

;-----------------------------------------------------------------------;
; INPUT:  SI points to byte after parameter end; BP points to parameter start. ;
; OUTPUT: BX = number.                                                  ;
; CALLS:  DECIMAL_INPUT, HEX_INPUT, OCTAL_INPUT, BINARY_INPUT.          ;
;-----------------------------------------------------------------------;
GET_NUMBER      PROC    NEAR
                DEC     SI                      ;Adjust pointer to parameter end.
                MOV     CX,SI                   ;Save SI.
                MOV     BX,BP                   ;Point to parameter start.
NEXT_CAP:       CMP     BX,CX                   ;Are we end of parameter?
                JZ      STRING_LENGTH           ;If yes, done here.
                LODSB                           ;Get a byte.
                CMP     AL,"a"
                JB      NEXT_CAP
                CMP     AL,"z"
                JA      NEXT_CAP
                AND     BYTE PTR [BX-1],5FH     ;Capitalize.
                JMP     SHORT NEXT_CAP

STRING_LENGTH:  MOV     BX,BP                   ;Point to parameter start.
                SUB     CX,BP                   ;Find parameter length.
                PUSH    CX                      ;Save it.

NEXT_RADIX:     XCHG    CX,BX                   ;Save count in BX.
                LODSB                           ;Get a byte.
                MOV     CX,RADIX_CNT            ;Count of radix appendixes in CB.
                MOV     DI,OFFSET RADIX_TYPE    ;Point to appendixes.
                REPNE   SCASB                   ;Is it an appendix?
                JZ      INPUT                   ;If yes, evaluate.
                XCHG    CX,BX                   ;Else, retrieve parameter count.
LOOP_RADIX:     LOOP    NEXT_RADIX              ;Check next byte.
                MOV     CX,RADIX_CNT            ;If no appendix, assume decimal.

INPUT:          SHL     CX,1                    ;Convert count to word pointer.
                MOV     DI,OFFSET CALLS_END     ;Point to input calls end.
                SUB     DI,CX                   ;Point to appropriate call.
                POP     CX                      ;Retrieve parameter length.
                MOV     BX,BP                   ;Point to parameter start.
                XOR     BX,BX                   ;Start with a zero number.
                CALL    [DI]                    ;Get the number.
                MOV     DX,OFFSET INVALID_MSG   ;Print error message if
                JNC     END_NUMBER              ; number invalid.
                CALL    PRINT_STRING
                JMP     SHORT ERROR_EXIT
END_NUMBER:     RET                             ;Else, return with number in BX.
GET_NUMBER      ENDP

;-----------------------------------------------------------------------;
; INPUT:  SI points to parameter start; CX = parameter length; BX = 0. ;
; OUTPUT: BX = number; CY = 0 if valid entry; CY = 1 if invalid entry. ;
;-----------------------------------------------------------------------;
DECIMAL_INPUT   PROC    NEAR
NEXT_DECIMAL:   LODSB                           ;Get a character.
                SUB     AL,"0"                  ;ASCII to binary.
                JC      LOOP_DECIMAL            ;If not between 0 and 9, skip.
                CMP     AL,9
                JA      LOOP_DECIMAL
                CBW                             ;Convert to word.
                XCHG    AX,BX                   ;Swap old and new number.
                PUSH    CX                      ;Preserve counter.
                MOV     CX,10                   ;Shift to left by multiplying
                MUL     CX                      ; last entry by ten.
                POP     CX                      ;Retrieve counter.
                JC      END_DECIMAL             ;If carry, too big.
                ADD     BX,AX                   ;Add new number and store in ax.
                JC      END_DECIMAL             ;If carry, too big.
LOOP_DECIMAL:   LOOP    NEXT_DECIMAL
                CLC
END_DECIMAL:    RET
DECIMAL_INPUT   ENDP

;-----------------------------------------------------------------------;
; INPUT  : SI points to parameter start; CX = parameter length; BX = 0. ;
; OUTPUT : BX = number; CY = 0 if valid entry; CY = 1 if invalid entry. ;
;-----------------------------------------------------------------------;
BINARY_INPUT    PROC    NEAR
NEXT_BIN:       LODSB                           ;Get a byte.
                SUB     AL,"0"                  ;ASCII to binary.
                JC      LOOP_BIN                ;If not 0 or 1, skip.
                CMP     AL,1
                JA      LOOP_BIN
                SHL     BX,1                    ;Shift old number left one bit.
                JC      END_BIN                 ;If carry, too big.
                OR      BL,AL                   ;Else, add it to the number.
LOOP_BIN:       LOOP    NEXT_BIN
                CLC
END_BIN:        RET
BINARY_INPUT    ENDP
```

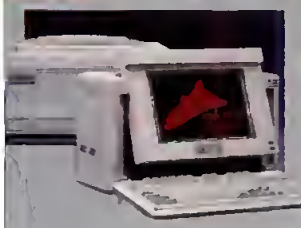
CONVERT.ASM: The assembly language source code for CONVERT.COM, which automatically displays either numbers or ASCII codes in their various number bases. You may need this to convert various escape sequences when you buy a new printer or modem.

Systems of Choice

QUALITY AT AN AFFORDABLE PRICE

PC MAGAZINE EDITOR'S CHOICE

"The Portacomp II is a value leader with fast memory, a fast drive controller and a terrific keyboard... Marvelously cheap powerful alternative... outperformed the other 286's." (Oct. 11, 1988)



PC MAGAZINE

"The Dataworld 286 (12 MHz) AT compatible [is] the fastest machine of the nine tested in the review." (Sep. 27, 1988)

PC MAGAZINE EDITOR'S CHOICE

"The Dataworld offers a 16-bit video system with a top-quality NEC Multisynch monitor and an exceptionally fast disk-drive controller for an impressive combination of value and performance... from a vendor with an increasing reputation for quality." (Feb. 28, 1989), 16 MHz system.

PORTACOMP II

STANDARD CONFIGURATION

- Intel 80286-12 micro-processor
- 512K base memory, expandable to 4MB on board
- Socket for Intel 80287-10 numeric coprocessor
- Two available 16-bit expansion slots
- Supertwist backlit LCD 9"x6" display, 640x400 resolution in CGA double-scan
- Dual hard/floppy controller
- 1.44MB 3.5" internal AND 1.2MB 5.25" external diskette drive
- 20MB, 48ms hard drive
- Enhanced 102-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 9-pin external monitor output port
- 150W power supply

AVAILABLE OPTIONS

- EGA gas plasma display
- Memory expansion to 640K, 1MB, 2MB, or 4MB
- 40 - 150MB hard drives with MFM, RLL, ESDI, or SCSI interface
- Numeric coprocessor: 80287
- 2400B internal or external modem
- Carrying case

Drive Configuration	LCD (CGA)	Plasma (CGA)	Plasma (EGA)
20MB, 48ms MFM	$2,195	$2,515	$2,695
44MB, 28ms 1:1 MFM	$2,404	$2,624	$2,804
80MB, 28ms 1:1 RLL	$2,404	$2,699	$2,899
60MB, 27ms SCSI	$2,599	$2,899	$3,099

DATA 286-12

STANDARD CONFIGURATION

- Intel 80286-12 micro-processor
- 512K base memory expandable to 4MB on board
- Socket for Intel 80287 numeric coprocessor
- 4 16-bit and 2 8-bit expansion slots
- Dual hard/floppy controller
- 1.2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 200W power supply

AVAILABLE OPTIONS

- Full-size vertical case or mini-tower case
- Memory expansion to 640K, 1MB, 2MB, or 4MB
- Numeric coprocessor: 80287
- 20MB to 300MB hard drives with MFM, RLL, ESDI, or SCSI interfaces
- 40MB - 150MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 102x768, color)
- 1.44MB 3.5" diskette drive

Drive Configuration	Standard Mono-	Standard VGA	Extended VGA
44MB, 25ms 1:1 MFM	$1,734	$2,304	$2,484
60MB, 25ms 1:1 RLL	$1,734	$2,039	$2,484
100MB, 25ms 1:1 RLL	$1,995	$2,299	$2,599
140MB, 22ms ESDI	$2,299	$2,165	$2,599

DATA 386-16/-20

STANDARD CONFIGURATION

- Intel 80386-16 or -20 micro-processor
- 1MB base RAM, expandable to 16MB of 32-bit memory
- LIM EMS 4.0 driver supplied
- Socket for Intel 80387 numeric coprocessor
- 1 32-bit, 5 16-bit and 2 8-bit slots
- Dual hard/floppy controller
- 1.2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 230W power supply

AVAILABLE OPTIONS

- Full-size vertical case or mini-tower case
- 32K static-RAM cache (with Austek cache controller) for 20MHz
- RAM upgrade to 2-, 4-, 8-, 12-, or 16-MB
- Numeric coprocessor: 80387
- 40MB - 150MB tape backup drives
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color) or extended VGA (800x600 up to 102x768, color)
- 1.44MB 3.5" diskette drive
- Weitek socket on 20 MHz

Drive Configuration	Standard Mono-	Standard VGA	Extended VGA
60MB, 25ms 1:1 RLL-16 MHz	$2,599	$2,799	$3,099
60MB, 25ms 1:1 RLL-20MHz	$2,599	$2,599	$3,099
140MB, 22ms ESDI-16MHz	$2,599	$3,099	$3,325
140MB, 22ms ESDI-20MHz	$2,599	$2,599	$4,025

DATA 386-25

STANDARD CONFIGURATION

- Intel 80386-25 micro-processor
- 1MB base memory RAM, expandable to 16MB of 32-bit memory
- LIM EMS 4.0 driver supplied
- Intel 82385-25 cache controller with 64KB of 35ns static, 2-way associated RAM cache.
- Socket for Intel 80387-25 or Weitek numeric coprocessor. Optional adapter will accomodate both 80387 and Weitek
- 1 32-bit, 5 16-bit and 2 8-bit slots
- Dual hard/floppy controller
- 1.2MB 5.25" floppy drive
- Enhanced 101-key "click" touch keyboard
- 1 parallel and 2 serial ports
- 230W power supply

AVAILABLE OPTIONS

- Full-size vertical case
- RAM upgrade to 2-, 4-, 8-, 12-, or 16MB
- Numeric coprocessors: 80387 or Weitek
- 40MB to 300MB hard drives with MFM, RLL, ESDI, or SCSI interface
- 40MB-150MB tape backup drive
- Available in standard monochrome (720x348, amber), standard VGA (640x480, color), or extended VGA (800x600 up to 1024x768, color)
- 1.44MB 3.5" diskette drive

Drive Configuration	Standard Mono-	Standard VGA	Extended VGA
44MB, 25ms 1:1 MFM	$2,599	$2,799	$2,999
60MB, 25ms 1:1 RLL	$3,099	$3,799	$3,999
100MB, 25ms 1:1 RLL	$3,699	$3,899	$4,120
150MB, 22ms ESDI	$4,220	$4,399	$4,725

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PC MAGAZINE EDITOR'S CHOICE

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```
CONVERT "A"
```

The numeric translation will be 1.

The one often-required ASCII character you *can't* simply enter within double quotes at the keyboard is Escape. You can get its equivalents (including its conventional left-arrow ASCII graphic) by entering the following:

```
CONVERT 27
```

You will, however, have to remember that Escape is decimal 27.

When CONVERTing large numbers, you will often find that *two* ASCII characters are displayed—for example, "(j" for 286Ah. Large numbers require two bytes (a *word*); CONVERT stores numbers as words in order to be able to handle values as high as 65,535. The ASCII symbols shown in such cases are the equivalents of each byte taken separately, and so should not be used for converting setup strings.

You'll also notice that for some numbers, one or the other of the two ASCII characters in the quotes will be blank. For example, CONVERT 65 actually displays

```
;-------------------------------------------------------------------;
; INPUT  : SI points to parameter start; CX = parameter length; BX = 0. ;
; OUTPUT : BX = number; CY = 0 if valid entry; CY = 1 if invalid entry. ;
;-------------------------------------------------------------------;
HEX_ISPUT       PROC    NEAR
NEXT_HEX:       LODSB                           ;Get a byte.
                SUB     AL,"0"                  ;ASCII to binary.
                JC      LOOP_HEX                ;If not 0 to 9, skip.
                CMP     AL,8                    ;Is it A - F ?
                JLE     NOT_ALPHA               ;If on, OK.
                SUB     AL,7                    ;Else, adjust for alpha.
                CMP     AL,18                   ;Is it punctuation?
                JN      LOOP_HEX                ;If yes, skip.
                CMP     AL,15                   ;Is it valid?
                JA      LOOP_HEX                ;If so, skip.
NOT_ALPHA:      TEST    BX,1111b SHL 12         ;Is the number going to overflow?
                STC                             ;Assume yes.
                JNZ     END_HEX                 ;If yes, too big.
                PUSH    CX                      ;Else, preserve counter.
                MOV     CL,4                    ;Shift old number four bits left.
                SHL     BX,CL
                POP     CX                      ;Retrieve counter.
                OR      BL,AL                   ;Add to number.
LOOP_HEX:       LOOP    NEXT_HEX
                CLC
END_HEX:        RET
HEX_INPUT       ENDP

;-------------------------------------------------------------------;
; ISPUT  : SI points to parameter start; CX = parameter length; BX = 0  ;
; OUTPUT : AX = number; CY = 0 if valid entry; CY = 1 if invalid entry  ;
;-------------------------------------------------------------------;
OCTAL_INPUT     PROC    NEAR
NEXT_OCTAL:     LODSB                           ;Get a byte.
                SUB     AL,"0"                  ;ASCII to binary.
                JC      LOOP_OCTAL              ;If not 0 through 7, skip.
                CMP     AL,7
                JA      LOOP_OCTAL
                TEST    BX,111b SHL 13          ;Is the number going to overflow?
                STC                             ;Assume yes.
                JNZ     END_OCTAL               ;If yes, too big.
                PUSH    CX                      ;Else, save counter.
                MOV     CL,3                    ;Shift old number left three bits
                SHL     BX,CL
                POP     CX                      ;Retrieve counter.
                OR      BL,AL                   ;Add to number.
LOOP_OCTAL:     LOOP    NEXT_OCTAL
                CLC
END_OCTAL:      RET
OCTAL_INPUT     ENDP

;-------------------------------------------------------------------;
; INPUT  : SI points to parameter start; CX = parameter length; BX = 0. ;
; OUTPUT : BX = number; CY = 0 if valid entry; CY = 1 if invalid entry. ;
;-------------------------------------------------------------------;
DECIMAL_OUTPUT  PROC    NEAR
                MOV     AX,SI                   ;Retrieve number.
                MOV     BX,10                   ;Divisor of ten.
                XOR     CX,CX                   ;Zero in counter.
NEXT_COUNT:     XOR     DX,DX                   ;Zero in high half.
                DIV     BX                      ;Divide by ten.
                ADD     DL,"0"                  ;Convert to ASCII.
                PUSH    DX                      ;Save results.
                INC     CX                      ;Also increment count.
                CMP     AX,0                    ;Are we done?
                JNZ     NEXT_COUNT              ;Continue until zero.
                MOV     WS,CX                   ;Save the number of characters.

NEXT_NUMBER:    POP     DX                      ;Retrieve numbers.
                CALL    PRINT_CHAR              ;And write them.
                LOOP    NEXT_NUMBER
                MOV     CX,SPACE_CNT + 5        ;Return with tab count.
                SUB     CX,WS
                RET
DECIMAL_OUTPUT  ENDP

;-----------------------------------;
; INPUT: SI = number.               ;
;-----------------------------------;
HEX_OUTPUT      PROC    NEAR
                MOV     BX,SI                   ;Retrieve number.
                MOV     CX,404H                 ;4 positions/word; 4bits/char.
ROTATE_HEX:     ROL     BX,CL                   ;Move highest bits to lowest.
                MOV     DL,BL
                AND     DL,1111B                ;Mask off all but four lowest.
                ADD     DL,"0"                  ;Convert to ASCII.
                CMP     DL,"9"                  ;Is it alpha.
                JLE     PRINT_HEX               ;If on, print it.
                ADD     DL,7                    ;Else, adjust.
PRINT_HEX:      CALL    PRINT_CHAR              ;And write them.
                DEC     CH                      ;Done all four positions?
                JNZ     ROTATE_HEX              ;If on, get next.

                MOV     DL,"h"                  ;Tack on hex character.
                CALL    PRINT_CHAR
                RET
HEX_OUTPUT      ENDP
```

```
;-----------------------------------;
; INPUT: SI = number.               ;
;-----------------------------------;
OCTAL_OUTPUT    PROC    NEAR
                MOV     BX,SI                   ;Retrieve number.
                MOV     CX,603H                 ;6 positions/word; 3bits/char.
                ROL     BX,1                    ;Special case first; get top bit.
                MOV     DL,BL
                RCR     DL,1                    ;Mask off all but that bit.
                JMP     SHORT OCTAL_ASCII       ;Write it.

OCTAL_ROTATE:   ROL     BX,CL                   ;Rotate highest 3 bits to lowest.
                MOV     DL,BL
                AND     DL,111B                 ;Mask off all but lowest 3 bits.
OCTAL_ASCII:    ADD     DL,"0"                  ;Convert to ASCII.
                CALL    PRINT_CHAR              ;Write it.
                DEC     CH                      ;Do all 6 positions.
                JNZ     OCTAL_ROTATE

                MOV     DL,"o"                  ;Tack on octal character.
                CALL    PRINT_CHAR
                RET
OCTAL_OUTPUT    ENDP

;-----------------------------------;
; INPUT: SI = number.               ;
;-----------------------------------;
BINARY_OUTPUT   PROC    NEAR
                MOV     BX,SI                   ;Retrieve number.
                MOV     CH,16                   ;Display all 16 positions.
ROTATE_BIN:     ROL     BX,1                    ;Move highest bit to lowest.
                MOV     DL,BL
                AND     DL,1                    ;Mask off all but lowest.
                ADD     DL,"0"                  ;Convert to ASCII.
                CALL    PRINT_CHAR
                CMP     CH,9                    ;Format with space between bytes.
                JNZ     SKIP_SPACE
                MOV     DL,SPACE
                CALL    PRINT_CHAR
SKIP_SPACE:     DEC     CH                      ;Do all 16 bits.
                JNZ     ROTATE_BIN

                MOV     DL,"b"                  ;Tack on binary character.
                CALL    PRINT_CHAR
                RET
BINARY_OUTPUT   ENDP

;-----------------------------------;
; INPUT: SI = number.               ;
;-----------------------------------;
ASCII_OUTPUT    PROC    NEAR
                XOR     BX,BX                   ;Page zero.
                MOV     AX,0E22H                ;Write TTY a quote mark.
                INT     10H                     ; via BIOS.

                MOV     CX,3                    ;Display 3 quotation marks and
                MOV     BX,0A22H                ; do not update cursor position.
                INT     10H
                MOV     CX,2                    ;Display the low byte twice
                MOV     AX,SI
                MOV     BX,0AX                  ; at current cursor position.
                INT     10H
                MOV     CX,1                    ;Display the high byte once
                MOV     BX,SI                   ; at current cursor position
                XCHG    AL,AH
                MOV     AH,0AH                  ; over the first low byte.
                INT     10H
                RET
ASCII_OUTPUT    ENDP

;-------------------------------------------------------------------;
; These subroutines print and separate the display with spaces. ;
;-------------------------------------------------------------------;
PRINT_CHAR      PROC    NEAR
                MOV     AH,2                    ;DOS display output.
                INT     21H                     ;Character is in DL.
                RET
PRINT_CHAR      ENDP

;-----------------------;
PRINT_STRING    PROC    NEAR
                MOV     AH,9                    ;DOS string output.
                INT     21H                     ;DX points to string
                RET                             ; terminated by "$".
PRINT_STRING    ENDP

;-----------------------;
SPACIOn         PROC    NEAR
                MOV     CX,SPACE_CNT            ;Retrieve space count between
SPACE_IT:       MOV     DL,SPACE                ; outputs and print via DOS.
                CALL    PRINT_CHAR
                LOOP    SPACE_IT
                RET
SPACING         ENDP

_TEXT           ENDS
                END     START
```

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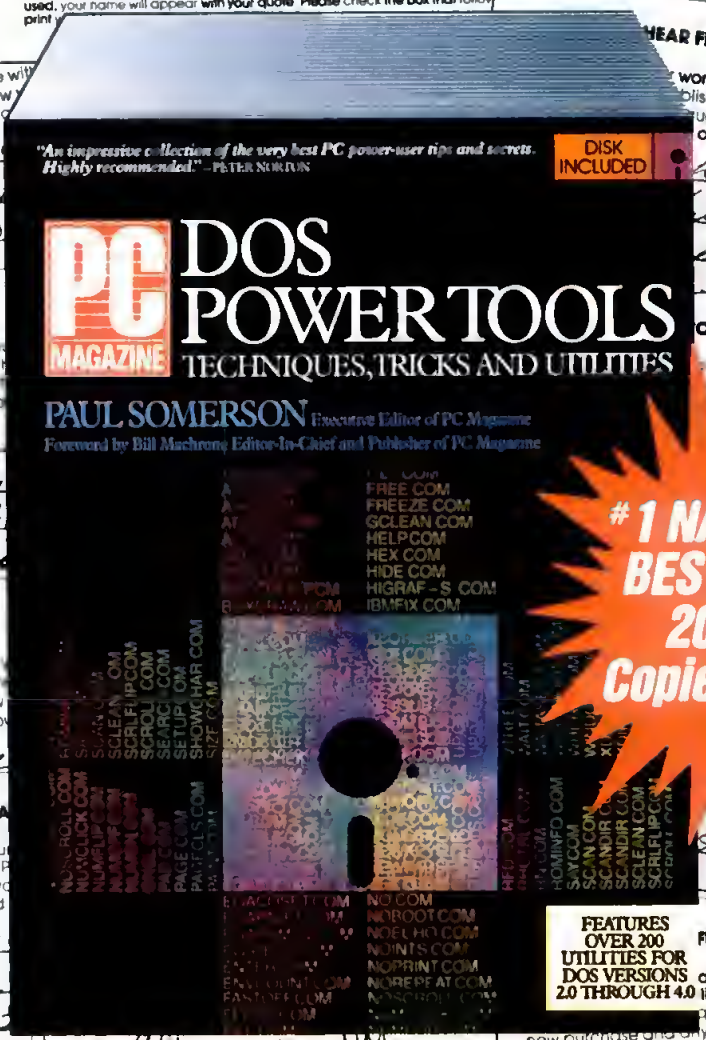

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" A" since the high byte is a null. In fact, the null character (decimal zero), the space character (decimal 32), and the blank character (decimal 255) all display as blanks.

ASCII AND BINARY

While CONVERT does all the work of number-base and ASCII translation for you, it may be useful to know in a general way what that work involves. For example, while 1 is 1 whether you're counting in binary, octal, decimal, or hexadecimal, it's not 1 at all when you enter it at your keyboard. The ASCII 1 you produce at the keyboard is actually the binary number 00110001, which is 49 decimal, 31 hex, and 61 octal, as you can see if you enter

```
CONVERT "1"
```

If you want your spreadsheet program to add 1 + 1, however, you obviously don't want it to add 49 + 49. The standard solution is to subtract an ASCII 0 (decimal 48, or 00110000b) from each numeral entered, thus converting from ASCII keystrokes to binary. Binary 00110001 minus binary 00110000 = 00000001b. Note that a program must reverse this process in order to display the character 1 on an ASCII terminal screen. The need to treat numbers differently when they're entered as ASCII-character numerals and when they're entered as intended numbers is one of the reasons CONVERT requires that ASCII characters be placed within double quotes.

BITS, BYTES, AND BASES

A number base, or *radix*, is determined by the number of different symbols that can be entered in a given column. There are 10 symbols (0 through 9) in the decimal system, and when we count more than 9 we begin counting again in a second column.

CONVERT does all the work of number-base and ASCII translation for you. But it is useful to know what that work involves.

Each column we move to the left represents a successively higher power of 10. In three columns, we can represent 1,000 possible values, 0 to 999.

Binary, or base 2 arithmetic, is natural to computers because their circuits are essentially switches, each of which can be turned either on or off, and each of which can be represented by a binary digit, or *bit*, of 1 or 0, respectively. In binary, each column we move to the left represents a successively higher power of 2. With three columns of bits, we can represent 8 possible values, 0 to 7, which is the origin of octal (base 8) computer numbers. When you count in octal, the symbols 0 through 7 have the same meanings as in normal decimal arithmetic. There are no single symbols for what we would call 8 and 9; these become 10 and 11, respectively.

The architecture of the computer does not conveniently accommodate our decimal system. Rather, the PC's architecture groups bits in units of 8 (that is, in bytes). With 8 bits there are 256 different combinations, which would require far too many different symbols to serve as a convenient number base. But *half* a byte—4 binary digits, or a *nibble* in programming jargon—makes a very convenient number base: 16 (hence, hexadecimal). Hex is manageable enough in terms of the number of its required symbols: 0 through 9 carry their traditional (decimal) meanings, and the letters A through F do duty for the decimal numbers 10 through 15. The advantage of hex is that it can *directly* represent the underlying binary language of the computer. Two hex digits represent one byte.

ASCII TO BINARY

The ASCII (American National Standard Code for Information Interchange) standard assigns a specific alphanumeric character or a control function (Form Feed, for example) to each of 256 possible numbers

CONVERT.BAS — **COMPLETE LISTING**

```
100 REM - BASIC PROGRAM TO CREATE CONVERT.COM
110 CLS:PRINT "Creating CONVERT.COM ": OPEN "CONVERT.COM " AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM%=0
130 FOR I = 1 TO  53
140   LINESUM%=0: LOCATE 2,3: PRINT "Countdown: "     52 - I ;
150   FOR J = 1 TO  16: READ BYTE$: BYTE = VAL("&H" + BYTE$)
160     CHECKSUM% = CHECKSUM% + BYTE: LINESUM% = LINESUM% + BYTE
170     IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180   NEXT J
190   READ LINETOT$: LINECHECK% = VAL("&H"+LINETOT$)
200   IF LINECHECK% = LINESUM% THEN GOTO 220
210   LOCATE 4,2: PRINT "Error in line 9"  ;  360 +  10 * I: GOTO 260
220 NEXT I
230 CLOSE: READ FILETOT$ : FILECHECK% = VAL(FILETOT$)
240 IF CHECKSUM% <> FILECHECK% THEN GOTO 360
250 PRINT: PRINT "CONVERT.COM  created successfully": SYSTEM
260 PRINT: PRINT "CONVERT.COM  is not valid!": END
270 DATA E9,  E,  1,  D,  30,  20,  20,  D,  A,  43,  4F,  4E,  56,  45,  52,  54,   36D
280 DATA 30,  31,  2E,  30,  36,  24,  43,  26,  20,  31,  39,  30,  36,  20,  5A,  66,   341
290 DATA 66,  66,  20,  43,  6F,  6D,  6D,  75,  6E,  66,  63,  61,  74,  99,  6F,  6E,   642
300 DATA 73,  20,  43,  6F,  2E,  D,  A,  50,  43,  20,  4D,  61,  67,  61,  7A,  66,   466
310 DATA 9E,  65,  30,  FE,  20,  4D,  69,  63,  68,  61,  65,  6C,  30,  4A,  2E,  30,   57C
320 DATA 4D,  65,  66,  66,  6F,  73,  64,  D,  A,  A,  53,  76,  6B,  74,  61,  70,   56E
330 DATA 3A,  20,  20,  43,  4F,  4E,  56,  45,  52,  54,  20,  6E,  75,  9D,  92,  65,   4D2
340 DATA 72,  5B,  2D,  6E,  75,  6D,  62,  65,  72,  5D,  5B,  72,  61,  94,  69,  70,   953
350 DATA 5D,  20,  7C,  30,  32,  63,  68,  01,  72,  61,  63,  74,  65,  72,  20,  73,   583
360 DATA 36,  22,  D,  A,  72,  91,  64,  90,  70,  3A,  20,  20,  62,  20,  3D,  30,  3D3
370 DATA 92,  69,  6E,  61,  72,  79,  2C,  20,  68,  20,  3D,  20,  68,  95,  70,  61,   55C
380 DATA 64,  65,  63,  69,  6D,  61,  6C,  2C,  20,  6F,  20,  3D,  20,  6F,  63,  74,   54D
390 DATA 61,  6C,  2,  A,  64,  65,  66,  01,  75,  6C,  74,  20,  69,  73,  20,  94,   549
400 DATA 65,  63,  69,  6D,  61,  6C,  A,  24,  1A,  46,  6E,  76,  61,  6C,  66,  64,   57A
416 DATA 30,  70,  61,  73,  61,  6D,  65,  74,  65,  72,  D,  A,  6E,  75,  6D,  62,   5AA
430 DATA 65,  72,  20,  72,  41,  6E,  67,  65,  3A,  30,  30,  30,  2D,  20,  36,  35,   466
436 DATA 35,  33,  35,  D,  A,  24,  40,  4F,  42,  FA,  3,  2A,  3,  50,  3,  17,   345
440 DATA  3,  FC,  00,  3E,  80,  0,  0,  75,  3,  E9,  06,  0,  B3,  A,  E0,  0,   5CB
450 DATA  3,  8E,  02,  0,  00,  E8,  AC,  3C,  0,  74,  35,  3C,  32,  74,  13,  3C,   579
460 DATA 2D,  75,  F3,  81,  FD,  02,  0,  75,  37,  59,  E0,  74,  0,  5E,  53,  E8,   77F
470 DATA E3,  33,  DB,  AC,  3C,  0,  74,  5D,  8A,  D8,  AC,  3C,  D,  74,  D,  3C,   6C0
480 DATA 33,  75,  5,  80,  3C,  22,  75,  4,  8A,  F8,  86,  F3,  33,  C9,  E8,  14,   6F1
490 DATA E8,  4E,  0,  33,  C9,  81,  FD,  02,  0,  74,  9,  59,  3E,  CE,  77,  2,   687
500 DATA 87,  D9,  2B,  CE,  41,  8B,  FB,  51,  E8,  F1,  0,  E8,  E8,  1,  E8,  E,   8D6
510 DATA  1,  E8,  A7,  1,  E8,  2C,  1,  E8,  A1,  1,  E8,  4E,  1,  E8,  6B,  1,   9E0
520 DATA E8,  6A,  1,  E2,  D,  E8,  99,  1,  B3,  A,  E8,  84,  1,  47,  59,  E2,   72F
530 DATA D6,  32,  C0,  EB,  0,  BA,  3,  1,  E8,  7B,  1,  E8,  1,  B4,  4C,  CD,   75E
540 DATA 21,  4E,  8B,  CE,  8E,  F5,  30,  F1,  74,  F,  AC,  3C,  61,  72,  F7,  3C,   7E5
550 DATA 7A,  77,  F3,  88,  44,  FF,  5F,  EB,  ED,  8B,  F5,  3E,  CD,  51,  87,  CB,   A16
560 DATA AC,  86,  3,  0,  BF,  4,  2,  F2,  AE,  74,  7,  87,  CB,  E2,  EF,  E6,   826
570 DATA  3,  0,  D1,  E1,  EF,  F,  3,  20,  F9,  59,  8B,  F5,  33,  D0,  FF,  15,   7A4
580 DATA 8A,  D9,  1,  73,  5,  E8,  2E,  1,  EB,  A8,  C3,  AC,  3C,  30,  72,  13,   709
590 DATA 3C,  4,  77,  F,  60,  43,  51,  E6,  A,  8,  F7,  E1,  56,  73,  7,  3,   5B7
600 DATA D8,  72,  3,  E2,  E9,  F8,  C3,  AC,  2C,  30,  72,  A,  3C,  1,  77,  6,   70E
610 DATA D1,  E3,  72,  5,  A,  D8,  E2,  EF,  F8,  C3,  AC,  2C,  30,  72,  1D,  3C,   66C
620 DATA  9,  7E,  A,  2C,  7,  3C,  A,  72,  13,  2C,  F,  77,  F,  F7,  C3,  8,   41A
630 DATA F8,  F9,  75,  B,  51,  B1,  4,  D3,  E3,  59,  A,  D8,  E2,  DC,  F8,  C3,   9D6
640 DATA AC,  2C,  30,  72,  13,  3C,  7,  77,  F,  F7,  C3,  8,  E8,  F9,  75,  B,   669
650 DATA 51,  B1,  3,  D3,  E3,  59,  A,  D8,  E2,  E6,  F8,  C3,  8E,  C7,  D8,  A,   990
660 DATA  8,  33,  C9,  33,  D2,  F7,  F3,  88,  C3,  30,  52,  41,  3D,  8,  8,  75,   6A2
670 DATA F2,  8B,  D9,  5A,  E8,  6A,  0,  E2,  FA,  B6,  A,  8,  3E,  CB,  C3,  8B,   915
680 DATA DF,  B9,  4,  4,  D3,  C3,  8A,  D3,  88,  E2,  F,  88,  C2,  30,  60,  FA,   8F8
690 DATA 39,  7E,  3,  88,  C2,  7,  E8,  78,  8,  FE,  CD,  75,  E7,  B2,  68,  E8,   88C
700 DATA 6F,  8,  C3,  8B,  DF,  E9,  3,  6,  B1,  C3,  8A,  D3,  88,  E3,  1,  EB,   89D
710 DATA  7,  D3,  C3,  8A,  D3,  88,  E2,  7,  88,  C2,  30,  E8,  83,  8,  FE,  CD,   8DB
720 DATA 75,  EF,  B3,  6F,  E8,  4A,  0,  C3,  8B,  DF,  B5,  10,  D1,  C3,  8A,  D3,   99A
730 DATA 88,  E3,  1,  88,  C3,  30,  E8,  30,  0,  88,  FD,  6,  75,  5,  B2,  20,   6C7
740 DATA E8,  3E,  0,  FB,  CD,  70,  E5,  E3,  62,  E8,  25,  0,  C3,  32,  FF,  E8,   988
750 DATA 22,  E,  CD,  10,  E6,  3,  0,  B8,  22,  A,  CD,  10,  E6,  2,  0,  8B,   4D8
760 DATA C7,  E4,  A,  CD,  10,  B6,  1,  0,  8B,  C7,  89,  C4,  B4,  A,  CD,  10,   753
770 DATA C3,  E4,  2,  CD,  21,  C3,  E4,  9,  CD,  21,  C3,  B9,  5,  0,  B2,  20,   728
780 DATA E8,  EE,  FF,  E2,  F9,  C3,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,   573
790 DATA 00551
```

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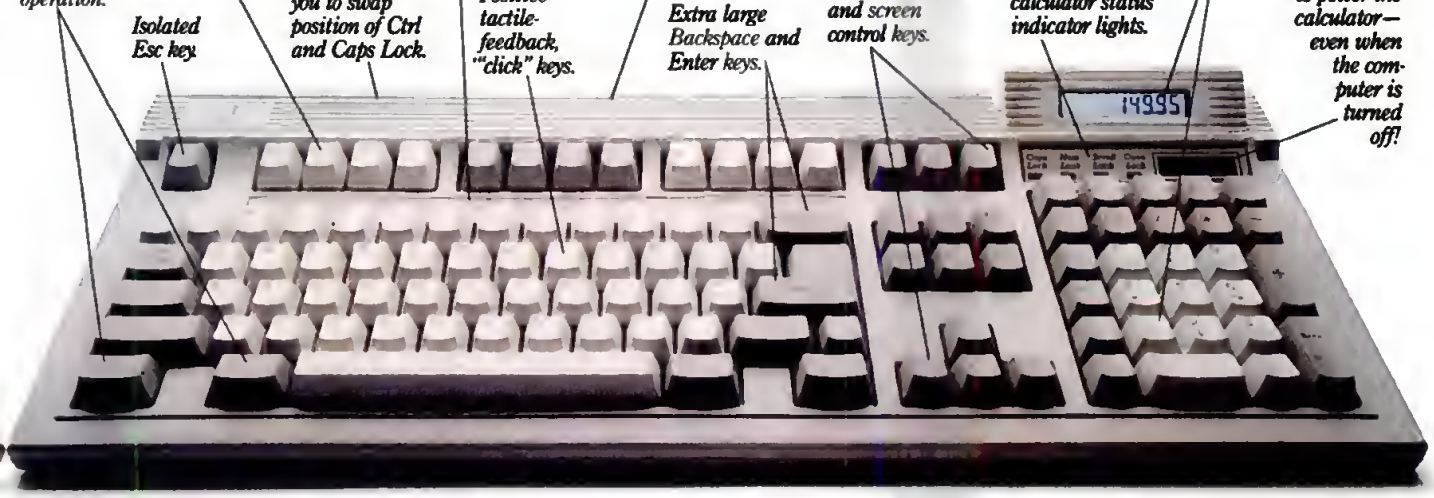

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Utilities

that can be represented by 1 byte. (Technically, ASCII covers only the first 127, leaving the "upper-order" ASCII values up for grabs. IBM made one set of assignments for the numbers from 128 to 255, and Apple and Microsoft opted for another. This is why the upper-order characters may appear different in *Windows* applications like *PageMaker*.)

Any character typed at the keyboard generates a specific ASCII code. To perform arithmetic, each individual ASCII character representing a number must first be changed into a binary number the computer can understand. As indicated previously, converting ASCII numbers to binary is a simple task of subtracting 48 from the ASCII character value. For example,

CONVERT can handle decimal numbers as large as 65,535—a two-byte word.

subtracting 48 from 54, the ASCII value for the character 6 results in the number 6.

That works fine for single-digit decimal numbers, but CONVERT can handle decimal numbers as large as 65,535—a two-byte word. The conversion process is simple enough, however, when you consider what is meant by a number such as 267, for instance. Each individual digit in 267 represents a count of increasing powers of ten. That is, we have 2 one hundreds plus 6 tens plus 7 ones. The ASCII representation of 267 would be three bytes with values 50, 54, and 55.

To convert the 50, 54, 55 bytes into the binary equivalent, first subtract 48 from each, resulting in the three bytes of value 2, 6, and 7, respectively. These individual bytes can then be accumulated after multiplying each byte by 10 to the power of its position. Two times 10 to the second power, plus 6 times 10 to the first power, plus 7 times 10 to the zero power results in the desired 267 and fits in one word.

In fact, there's another way to do the

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CONVERT Command

Michael J. Mefford July 1989 (Utilities)

Purpose: Simultaneously displays an ASCII code or whole number between 0 and 65,535 in its hexadecimal, decimal, octal, and binary equivalents; especially useful in translating printer, modem, or EGA monitor escape sequences and setup strings from one number base to another.

Format:

```
CONVERT number[-number]|base] | "character(s)"
```

Remarks: Either a single *number* or a *number-number* range may be input to CONVERT for multiple number base display. Decimal input is assumed, unless otherwise indicated, by adding b (binary), o (octal), or h (hexadecimal) to the *number*(s). An ASCII code to be converted must be placed within double quotes. Control codes (for example, Ctrl-A) may be entered normally at the keyboard (within double quotes), with the exception of the escape character. To display the equivalents (including the ASCII left-arrow graphic) of the escape character, enter **CONVERT 27**.

When large numbers are converted, the 2-byte sequence displayed within quotes in the right-hand column as the ASCII "equivalent" should not be used in translating setup strings. It represents the individual byte values, not the value of the combination. Note, too, that in this display, decimal 0 (null), 32 (space), and 255 (blank) all appear as blanks.

The output from CONVERT may be redirected to a printer or to a file, so a multiline table of values can be created. When redirection is used, however, the ASCII equivalent normally shown in the right-hand column is dropped.

Available for downloading from PC MagNet (see the "CONVERT by Modem" sidebar), CONVERT.COM is already compiled and ready to run. As an alternative, CONVERT.COM can be created from either of two program files that are printed in the article and are also available for downloading from PC MagNet. CONVERT.BAS will automatically create CONVERT.COM when run once in BASIC. To create CONVERT.COM from the CONVERT.ASM source code requires the use of a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM CONVERT;
LINK CONVERT;
EXE2BIN CONVERT CONVERT.COM;
```

multiplication that better fits the microprocessor's instruction set, since there is no "to the power of" instruction. Ten to the second power is really just 10 * 10. Multiplying a number by 10 effectively shifts the number one place to the left.

Visualize, then, that our number, 267, appears one digit at a time, starting with the leftmost digit, 2. As each new digit appears, the old digits are shifted one column to the left to make room for the new digits. The shift is accomplished by multiplying by 10, as illustrated in Figure 1. We always start out with a zero on the left end of the number and process the digits from left to right. First we process the 2 by shifting the 0 left (0 * 10 = 0) and adding the 2. Next the 6 enters by shifting the 2 left (2 * 10 = 20) and adding in the 6. Lastly, the 26 is shifted left (26 * 10 = 260) and adding in the 7. Voilà! 267.

HOW CONVERT MULTIPLIES

0	2	26
x 10	x 10	x 10
0	20	260
+ 2	+ 6	+ 7
2	26	267

Figure 1: This is the way CONVERT tabulates multiplication. The result in each column is used as the starting value for the calculations in the next column. The starting value is multiplied by 10, which, in effect, shifts the number one place to the left. That makes room for the addition of the digit to its right. The algorithm is initialized with zero for the first multiplication.

MULTIPLYING BY SHIFTING

Conversion of the other radixes from their ASCII representation to binary can be done similarly, using the appropriate base for the multiplicand. And actually, since binary, hexadecimal, and octal are all factors of binary, there's a shortcut to the multiplication step.

There are several machine instructions that will *shift* a number by a requested number of bits either left or right. These instructions are much more efficient than the MUL (multiply) instruction. The shift instruction best suited for multiplying is SHL (shift left). Multiplying a binary number by its base of two is as simple as shifting the bits of the number one position to the left. Since an octal base requires three bits, multiplication is accomplished by shifting a number three positions to the left. Similarly a hexadecimal number is shifted four positions.

To illustrate, let's convert hexadecimal ASCII number 5Fh to binary. The first part of the conversion is the same as the decimal conversion—subtract 48, the ASCII value of the character 0. (As depicted in Figure 2, another subtraction of 7 must be performed for the letter F digit. This is to adjust for the letters' position in the ASCII table relative to the number characters.) The result is a byte with a value of 15, representing the first place, and a second byte with a value of 5 in the second position. If this were a decimal conversion, the next step would be to combine the numbers by multiplying the 5 by base 10 and adding in the 15. For hexadecimal, instead of multiplying by the base 16, the same can be ac-

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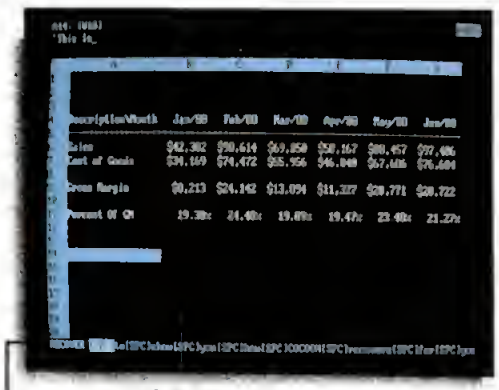

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ASCII-TO-BINARY CONVERSION

ASCII hexadecimal number	5	F
ASCII value of bytes	53	70
Subtract ASCII of "0"	- 48	- 48
	5	22
Subtract 7 for letters		- 7
	5	15

The 5 is multiplied by 16 by shifting 4 bits to the left.

	5	15
Binary	0101b	1111b

```
0101 SHL 4 bits = 0101 0000
                + 1111
                  10101 1111b or 95 decimal
```

Figure 2: The first step of converting a hexadecimal ASCII number to binary is the same as for a decimal ASCII number: subtract 48, the ASCII value for 0. An additional subtraction of 7 has to be performed for letter digits, to reflect their position in the ASCII table relative to the number characters. Note that a single subtraction of 55 from letter digits would accomplish the same in one step, but computer instruction logic lends itself better to the two-step subtraction. The next step, combining the byte of 5 and byte of 15, is made by multiplying the 5 by the base 16 and adding in the 15. The multiplication portion can be done by shifting the binary equivalent of 5 (0101) four bits to the left.

complished by shifting the 5's binary representation 4 bits to the left and then adding the binary 15.

BINARY TO ASCII

Once the input is converted to binary, conversion to the four radixes displayed by CONVERT is essentially the reverse of the ASCII-to-binary conversions. For example, for decimal output, instead of multiplying by 10, the binary number is divided by 10 and the remainder is converted into ASCII by adding, instead of subtracting, 48. The quotient is repeatedly divided by 10 until the remainder is zero.

How deeply you will explore the various permutations in the commented source code depends on your need to write assembly language programs. The conversion procedures in CONVERT were written so that you could directly import them into your assembly program and use them as they are or with slight modification. Rather than search for a conversion table, the next time you need to check a printer setup string, just type in CONVERT. ■

Michael J. Mefford is a contributing editor of PC Magazine.

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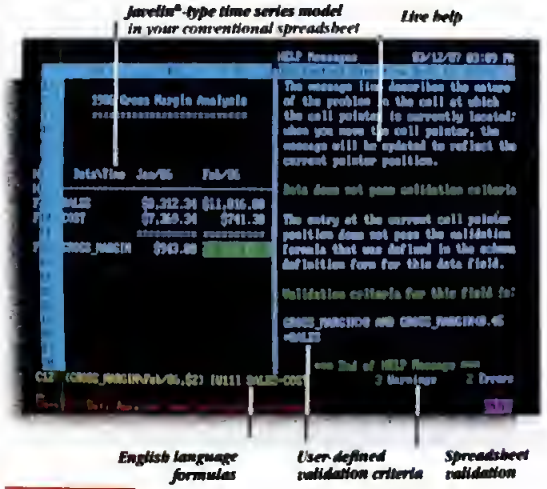

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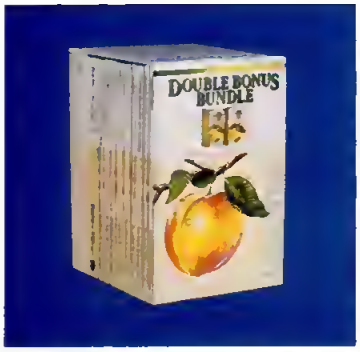

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CIRCLE 358 ON READER SERVICE CARD

by
Charles Petzold

Environments

In the last issue I introduced you to TAQUIN, a Presentation Manager version of "14–15," the classic move-the-squares puzzle, and I discussed five of the six files used to create the program. It's time to discuss the sixth and most important, the C source code file. The TAQUIN.C listing is shown in Figure 1. All of the program's files, including a fully compiled .EXE version, are available on PC MagNet.

TAQUIN.C makes use of more than 30 PM function calls. You can get a detailed discussion of each by checking either the IBM or Microsoft OS/2 technical reference manuals. I won't go into their precise syntax and details. Rather, I will discuss the program as a whole.

The program begins by including several header files. These are: OS2.H (which defines the new data types, identifiers, and functions used in Presentation Manager programs); STDLIB.H (which declares the C `itoa`, `rand`, and `srand` functions and the min and max macros used in the program); and TAQUIN.H, which I discussed last time. Four constants are then defined; they set the puzzle's row and column dimensions, the number of repetitions used in scrambling the squares, and the size of the squares (in 1/100-inch increments). Within reasonable limits, you can change the values of these constants and recompile the program.

THE FUNCTION MAIN

As in most C programs, TAQUIN begins and ends its life in the `main` function. As in most Presentation Manager programs, the `main` function is dedicated to some fairly standard overhead. Program initialization in `main` culminates with a call to WinCreateStdWindow to create the program's window. The *flFrameFlags* variable, passed as the third parameter of the function, determines many of the characteristics of the window. This variable is initialized with various FCF (frame creation flag) identifiers. TAQUIN's window has a system menu, a title bar, a border (but not a sizing border), a minimize button (but not a maximize button), a menu, and an icon.

When executing the WinCreateStdWindow function, the Presentation Manager must access TAQUIN's menu template and icon, both of which are stored as resources in the TAQUIN.EXE file. The penultimate parameter to WinCreateStdWindow is the identifier ID_RESOURCE. This identifier is defined in TAQUIN.H and is also used in the ICON and MENU definitions in TAQUIN.RC.

The WinCreateStdWindow function creates several windows, including the frame window, system menu window, minimize window, and menu window. It also creates the client window, which displays the puzzle and interprets the keyboard and mouse input. Messages to the client window are processed by the ClientWndProc function in TAQUIN.C.

More specifically, the client window is based on a window class named "Taquin," which is a text string stored in the szClientClass variable and passed as the fourth parameter to WinCreateStdWindow. Before creating the window, TAQUIN registers the window class by calling WinRegisterClass. That function associates the class name with a window procedure, in this case ClientWndProc.

After creating the program's window, TAQUIN then enters a typical Presentation Manager message loop, which consists of two functions: WinGetMsg and WinDispatchMsg. The WinGetMsg function retrieves messages from the program's message queue. The queued messages include input from the keyboard and mouse, messages from the program's menu, paint messages, and a quit message. With the exception of the quit message (which causes WinGetMsg to return zero), all the messages are sent by the WinDispatchMsg function to the appropriate window procedure. In the case of messages to the client window, this window procedure is ClientWndProc.

The quit message, which is placed in the message queue when the user selects Close from the system menu, causes TAQUIN to drop out of the message loop. TAQUIN then begins its cleanup by calling WinDestroyWindow to destroy the frame window. All the children of the frame window (including the client window) are also destroyed.

THE CLIENT WINDOW PROCEDURE

ClientWndProc processes messages sent to the window. Each message is a call from the Presentation Manager to the ClientWndProc function. The *hwnd* parameter contains the window's handle, and the *msg* parameter is a number that identifies the message. The message parameters *mp1* and *mp2* contain additional information about the message.

It is customary to use a "switch and case" construction to process these messages. That's to say, the *msg* parameter to the window procedure is compared with various identifiers that begin with the WM (window message) prefix. ClientWndProc processes only five messages. They are:

- WM_CREATE. This is the first message a window procedure receives. ClientWndProc gets a WM_CREATE message during the WinCreateStdWindow call in `main`. (Other messages received by ClientWndProc during the WinCreateStdWindow call in `main` are ignored, and are passed on to WinDefWin-

dowProc for default processing.)

- WM_PAINT. This message indicates that part of the client window is invalid and must be repainted. All the window drawing in TAQUIN.C occurs during the WM_PAINT message.
- WM_BUTTON1DOWN. ClientWndProc receives a WM_BUTTON1DOWN message when the first mouse button is pressed while the mouse pointer is positioned over the client window. The *mp1* message parameter contains the coordinates of the mouse at the time the button was pressed.
- WM_CHAR. If a key is pressed or released while TAQUIN has the input focus (indicated by a highlighted title bar), the window procedure gets a WM_CHAR message. The *mp1* and *mp2* parameters contain information to identify the key.
- WM_COMMAND. The menu window posts this message to the client window when an item is selected from the program's menu. In this case, the *mp1* message parameter indicates the selected menu item.

All messages that a window procedure does not process are passed to the WinDefWindowProc function for default processing. This function is called at the bottom of ClientWndProc.

Most of the variables used in ClientWndProc are used only while processing a single message, so they are defined as normal, automatic variables. The several variables used for things that must be retained from message to message are defined as static.

The *asPuzzle* variable is a static array of SHORT integers that stores the current square number for each row and column position in the puzzle. (GPI coordinates are relative to the lower-left part of the window, and I have followed this convention in indexing the array. The 0 row in the array is thus the bottom rather than the top row.) The blank square is stored as a 0 in this array. The *sBlankRow* and *sBlankCol* are also static variables. These variables store the row and column coordinates of the blank square.

The static variables *cxSquare* and *cySquare* store the width and height (in pixels) of each individual square. This information is needed both to process mouse input and to draw the squares of the puzzle.

WM_CREATE: WINDOW INITIALIZATION

ClientWndProc receives its first batch of messages during the call to WinCreateStdWindow in `main`. The first message ClientWndProc gets is WM_CREATE. This is the time to do some initialization.

TAQUIN's first job when it gets the WM_CREATE message is to initialize *cxSquare* and *cySquare*, which set the width and height of the squares, in pixels. After experimentation, I decided that the individual squares in TAQUIN should measure ⅔ inch on each side. But ⅔ inch is a different number of pixels on different video displays. So, the nine lines of code that begin "WM_CREATE message processing" obtain this dimension in pixels.

The code begins by obtaining a presentation space, and then setting the "page units" to PU_LOENGLISH. This means that 1/100-inch units will be used in drawing. We don't actually do any drawing with this presentation space, however. Instead, a POINTL structure (the variable *ptl*) is initialized with the SQUARESIZE value. It is then converted to device coordinates (or pixels) by calling GpiConvert. The results are stored in *cxSquare* and *cySquare*.

TAQUIN.C then uses this information in order to calculate a position and a size for the client window that is on the screen. The four fields of the RECTL (rectangle) structure named *rcl* are set to the screen coordinates of the four corners of the client window. The WinCalcFrameRect function converts these to frame-window coordinates, which are then used in WinSetWindowPos.

WM_CREATE processing concludes with a call to WinSendMsg. This function sends a WM_COMMAND message to ClientWndProc to initialize the *szPuzzle*, *sBlankRow*, and *sBlankCol* variables. I'll discuss this message more fully below; here it is sufficient to know that the WM_COMMAND message is equivalent to the user selecting "Normal Reset" from the program's menu.

WM_PAINT: PAINTING THE PUZZLE

After the WinCreateStdWindow function returns in `main`, the program enters the message loop, where it retrieves messages from the queue by calling WinGetMsg and sends them to the appropriate window procedure by calling WinDispatchMsg. In general, the first message retrieved from the message queue is WM_PAINT. ClientWndProc responds to it by repainting the window.

ClientWndProc begins processing WM_PAINT by making a call to WinBeginPaint to obtain a handle for a presentation space. It ends WM_PAINT with a call to WinEndPaint to release that handle. The RECTL structure named *rclInvalid* is passed as the last parameter to WinBeginPaint to get the coordinates of the invalid

TAQUIN.C 1 of 2

```
/*--------------------------------------------------------
   TAQUIN.C -- Jeu de Taquin for OS/2 Presentation Manager
               (c) 1989, Riff Communications Co.
               PC Magazine * Charles Petzold, January 1989
  --------------------------------------------------------*/

#define INCL_WIN                // include 'Win' functions in OS/2 headers
#define INCL_GPI                // include 'Gpi' functions in OS/2 headers
#include <os2.h>
#include <stdlib.h>
#include "taquin.h"

#define NUMROWS         4       // greater than or equal to 2
#define NUMCOLS         4       // greater than or equal to 3
#define SCRAMBLEREP   100       // make larger if using more than 16 square
#define SQUARESIZE     67       // in 1/100th inch

MRESULT EXPENTRY ClientWndProc (HWND, USHORT, MPARAM, MPARAM) ;
MRESULT EXPENTRY AboutDlgProc  (HWND, USHORT, MPARAM, MPARAM) ;

int main (void)
     {
     static CHAR  szClientClass[] = "Taquin" ;
     static ULONG flFrameFlags = FCF_SYSMENU  | FCF_TITLEBAR |
                                 FCF_BORDER   | FCF_SHELLPOSITION |
                                 FCF_MENU     | FCF_ICON |
                                 FCF_TASKLIST ;
```

```
     HAB     hab ;
     HMQ     hmq ;
     HWND    hwndFrame, hwndClient ;
     QMSG    qmsg ;
                         // Initialize and create standard window

     hab = WinInitialize (0) ;
     hmq = WinCreateMsgQueue (hab, 0) ;
     WinRegisterClass (hab, szClientClass, ClientWndProc, 0L, 0) ;
     hwndFrame = WinCreateStdWindow (HWND_DESKTOP, WS_VISIBLE,
                                     &flFrameFlags, szClientClass, NULL,
                                     0L, NULL, ID_RESOURCE, &hwndClient) ;

                         // Get messages from queue and dispatch them

     while (WinGetMsg (hab, &qmsg, NULL, 0, 0))
          WinDispatchMsg (hab, &qmsg) ;

                         // Clean up and terminate

     WinDestroyWindow (hwndFrame) ;
     WinDestroyMsgQueue (hmq) ;
```

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Figure 1: The C source code listing for the TAQUIN puzzle makes use of more than 30 Presentation Manager function calls.

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TAQUIN.C 2 of 2

```
        WinTerminate (hab) ;
        return 0 ;
        }

MRESULT EXPENTRY ClientWndProc (HWND hwnd, USHORT msg, MPARAM mp1, MPARAM mp2)
        {
        static SHORT asPuzzle[NUMROWS][NUMCOLS],
                     sBlankRow, sBlankCol, cxSquare, cySquare ;
        CHAR         szNum[5] ;
        HPS          hps ;
        HWND         hwndFrame ;
        POINTL       ptl ;
        RECTL        rcl, rclInvalid, rclIntersect ;
        SHORT        sRow, sCol, sMouseRow, sMouseCol, i ;
        SIZEL        sizl ;

    switch (msg)
        {
        case WM_CREATE:
                            // Calculate square size in pixels

             hps = WinGetPS (hwnd) ;
             sizl.cx = 0 ;
             sizl.cy = 0 ;
             GpiSetPS (hps, &sizl, PU_LOMETRIC) ;
             ptl.x = SQUARESIZE ;
             ptl.y = SQUARESIZE ;
             GpiConvert (hps, CVTC_PAGE, CVTC_DEVICE, 1L, &ptl) ;
             WinReleasePS (hps) ;

             cxSquare = (SHORT) ptl.x ;
             cySquare = (SHORT) ptl.y ;

                            // Calculate client window size and position

             rcl.xLeft   = (WinQuerySysValue (HWND_DESKTOP, SV_CXSCREEN) -
                                NUMCOLS * cxSquare) / 2 ;
             rcl.yBottom = (WinQuerySysValue (HWND_DESKTOP, SV_CYSCREEN) -
                                NUMROWS * cySquare) / 2 ;
             rcl.xRight  = rcl.xLeft   + NUMCOLS * cxSquare ;
             rcl.yTop    = rcl.yBottom + NUMROWS * cySquare ;

                            // Set frame window position and size

             hwndFrame = WinQueryWindow (hwnd, QW_PARENT, FALSE) ;
             WinCalcFrameRect (hwndFrame, &rcl, FALSE) ;
             WinSetWindowPos  (hwndFrame, NULL,
                               (SHORT) rcl.xLeft, (SHORT) rcl.yBottom,
                               (SHORT) (rcl.xRight - rcl.xLeft),
                               (SHORT) (rcl.yTop - rcl.yBottom),
                               SWP_MOVE | SWP_SIZE | SWP_ACTIVATE) ;

                            // Initialize the asPuzzle array

             WinSendMsg (hwnd, WM_COMMAND, MPFROMSHORT (IDM_NORMAL), NULL) ;
             return 0 ;

        case WM_PAINT:
             hps = WinBeginPaint (hwnd, NULL, &rclInvalid) ;

                            // Draw the squares

             for (sRow = NUMROWS - 1 ; sRow >= 0 ; sRow--)
                  for (sCol = 0 ; sCol < NUMCOLS ; sCol++)
                       {
                       rcl.xLeft   = cxSquare * sCol ;
                       rcl.yBottom = cySquare * sRow ;
                       rcl.xRight  = rcl.xLeft   + cxSquare ;
                       rcl.yTop    = rcl.yBottom + cySquare ;

                       if (!WinIntersectRect (NULL, &rclIntersect,
                                              &rcl, &rclInvalid))
                            continue ;

                       if (sRow == sBlankRow && sCol == sBlankCol)
                            WinFillRect (hps, &rcl, CLR_BLACK) ;
                       else
                            {
                            WinDrawBorder (hps, &rcl, 5, 5,
                                           CLR_PALEGRAY, CLR_DARKGRAY,
                                           DB_STANDARD | DB_INTERIOR) ;
                            WinDrawBorder (hps, &rcl, 2, 2,
                                           CLR_BLACK, 0L, DB_STANDARD) ;
                            WinDrawText (hps, -1,
                                    itoa (asPuzzle[sRow][sCol], szNum, 10),
                                    &rcl, CLR_WHITE, CLR_DARKGRAY,
                                    DT_CENTER | DT_VCENTER) ;
                            }
                       }
             WinEndPaint (hps) ;
             return 0 ;

        case WM_BUTTON1DOWN:
             sMouseCol = MOUSEMSG(&msg)->x / cxSquare ;
             sMouseRow = MOUSEMSG(&msg)->y / cySquare ;

                            // Check if mouse was in valid area

             if ( sMouseRow < 0           || sMouseCol < 0           ||
                  sMouseRow >= NUMROWS    || sMouseCol >= NUMCOLS    ||
                 (sMouseRow != sBlankRow && sMouseCol != sBlankCol)  ||
                 (sMouseRow == sBlankRow && sMouseCol == sBlankCol))
                       break ;

                            // Move a row right or left

             if (sMouseRow == sBlankRow)
                  {
                  if (sMouseCol < sBlankCol)
                       for (sCol = sBlankCol ; sCol > sMouseCol ; sCol--)
                            asPuzzle[sBlankRow][sCol] =
                                 asPuzzle[sBlankRow][sCol - 1] ;
                  else
                       for (sCol = sBlankCol ; sCol < sMouseCol ; sCol++)
                            asPuzzle[sBlankRow][sCol] =
                                 asPuzzle[sBlankRow][sCol + 1] ;
                  }
                            // Move a column up or down
             else
                  {
                  if (sMouseRow < sBlankRow)
                       for (sRow = sBlankRow ; sRow > sMouseRow ; sRow--)
                            asPuzzle[sRow][sBlankCol] =
                                 asPuzzle[sRow - 1][sBlankCol] ;
                  else
                       for (sRow = sBlankRow ; sRow < sMouseRow ; sRow++)
                            asPuzzle[sRow][sBlankCol] =
                                 asPuzzle[sRow + 1][sBlankCol] ;
                  }
                            // Calculate invalid rectangle

             rcl.xLeft   = cxSquare * min (sMouseCol, sBlankCol) ;
             rcl.yBottom = cySquare * min (sMouseRow, sBlankRow) ;
             rcl.xRight  = cxSquare * (max (sMouseCol, sBlankCol) + 1) ;
             rcl.yTop    = cySquare * (max (sMouseRow, sBlankRow) + 1) ;

                            // Set new array and blank values

             sBlankRow = sMouseRow ;
             sBlankCol = sMouseCol ;
             asPuzzle[sBlankRow][sBlankCol] = 0 ;

                            // Invalidate rectangle

             WinInvalidateRect (hwnd, &rcl, FALSE) ;
             break ;
        case WM_CHAR:
             if (!(CHARMSG(&msg)->fs & KC_VIRTUALKEY) ||
                   CHARMSG(&msg)->fs & KC_KEYUP)
                       return 0 ;

                            // Mimic a WM_BUTTON1DOWN message

             sMouseCol = sBlankCol ;
             sMouseRow = sBlankRow ;

             switch (CHARMSG(&msg)->vkey)
                  {
                  case VK_LEFT:   sMouseCol++ ;  break ;
                  case VK_RIGHT:  sMouseCol-- ;  break ;
                  case VK_UP:     sMouseRow-- ;  break ;
                  case VK_DOWN:   sMouseRow++ ;  break ;
                  default:        return 0 ;
                  }
             WinSendMsg (hwnd, WM_BUTTON1DOWN,
                         MPFROM2SHORT (sMouseCol * cxSquare,
                                       sMouseRow * cySquare), NULL) ;
             return 0 ;

        case WM_COMMAND:
             switch (COMMANDMSG(&msg)->cmd)
                  {
                            // Initialize asPuzzle array

                  case IDM_NORMAL:
                  case IDM_INVERT:
                       for (sRow = 0 ; sRow < NUMROWS ; sRow++)
                            for (sCol = 0 ; sCol < NUMCOLS ; sCol++)
                                 asPuzzle[sRow][sCol] = sCol + 1 +
                                      NUMCOLS * (NUMROWS - sRow - 1) ;

                       if (COMMANDMSG(&msg)->cmd == IDM_INVERT)
                            {
                            asPuzzle[0][NUMCOLS-2] = NUMCOLS * NUMROWS - 2 ;
                            asPuzzle[0][NUMCOLS-3] = NUMCOLS * NUMROWS - 1 ;
                            }
                       asPuzzle[sBlankRow = 0][sBlankCol = NUMCOLS - 1] = 0 ;
                       WinInvalidateRect (hwnd, NULL, FALSE) ;
                       return 0 ;

                            // Randomly scramble the squares

                  case IDM_SCRAMBLE:
                       WinSetPointer (HWND_DESKTOP, WinQuerySysPointer (
                                      HWND_DESKTOP, SPTR_WAIT, FALSE)) ;

                       srand ((int) WinGetCurrentTime (NULL)) ;

                       for (i = 0 ; i < SCRAMBLEREP ; i++)
                            {
                            WinSendMsg (hwnd, WM_BUTTON1DOWN,
                                 MPFROM2SHORT ((rand() % NUMCOLS * cxSquare,
                                      sBlankRow * cySquare), NULL) ;
                            WinUpdateWindow (hwnd) ;

                            WinSendMsg (hwnd, WM_BUTTON1DOWN,
                                 MPFROM2SHORT (sBlankCol * cxSquare,
                                      rand() % NUMROWS * cySquare), NULL) ;
                            WinUpdateWindow (hwnd) ;
                            }

                       WinSetPointer (HWND_DESKTOP, WinQuerySysPointer (
                                      HWND_DESKTOP, SPTR_ARROW, FALSE)) ;
                       return 0 ;

                            // Display dialog box

                  case IDM_ABOUT:
                       WinDlgBox (HWND_DESKTOP, hwnd, AboutDlgProc,
                                  NULL, IDD_ABOUT, NULL) ;
                       return 0 ;
                  }
             break ;
        }
    return WinDefWindowProc (hwnd, msg, mp1, mp2) ;
    }

MRESULT EXPENTRY AboutDlgProc (HWND hwnd, USHORT msg, MPARAM mp1, MPARAM mp2)
    {
    switch (msg)
        {
        case WM_COMMAND:
             switch (COMMANDMSG(&msg)->cmd)
                  {
                  case DID_OK:
                  case DID_CANCEL:
                       WinDismissDlg (hwnd, TRUE) ;
                       return 0 ;
                  }
             break ;
        }
    return WinDefDlgProc (hwnd, msg, mp1, mp2) ;
    }
```

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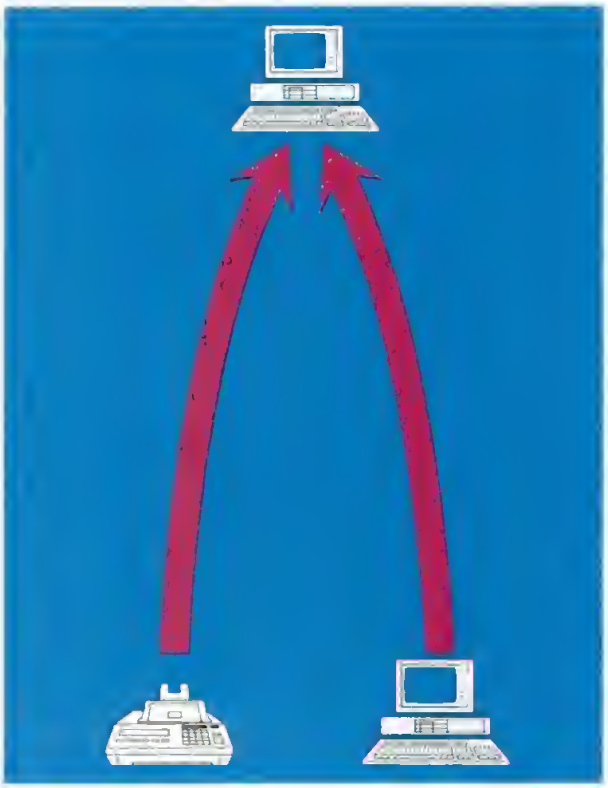

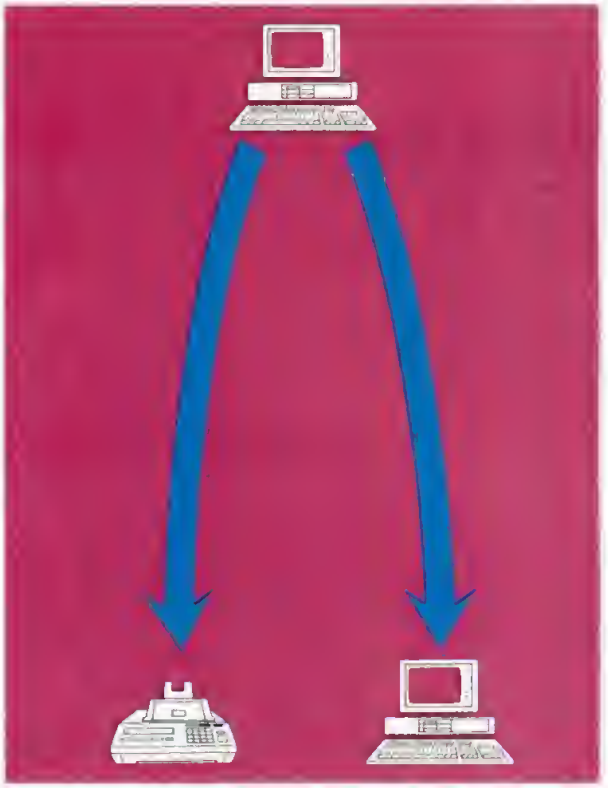

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rectangle—the area of the window that must be repainted. For the first WM_PAINT message the program receives, of course, these coordinates encompass the entire window.

The two *for* loops go through all the rows and columns to paint the squares. The fields of *rcl* are successively set to the coordinates of each square. If this rectangle does not intersect the invalid rectangle, the square is not repainted. (It's not necessary to make this check, but it speeds up window repainting.)

You would normally use the Graphics Programming Interface (GPI) functions when drawing in the Presentation Manager. There are a few high-level non-GPI drawing functions, however, and TAQUIN uses three of them. These Win functions (they all use a Win prefix) work only on the screen and do not affect printers.

The Win drawing functions used here all work on rectangles, so the *rcl* variable is passed to each of them. The WinFillRect function colors the blank square black. For the other squares, the first WinDrawBorder function draws a light gray rectangle surrounded by a dark gray border. The second WinDrawBorder draws a black border for the space between the squares. The WinDrawText function displays the numeral inside the square.

WM_BUTTON1DOWN: MOUSE CLICKS

TAQUIN handles the bulk of user input during the WM_BUTTON1DOWN message. This message is placed in the message queue when you press the first mouse button (normally the left mouse button) while the mouse is positioned over the client window.

The *mp1* parameter that accompanies a WM_BUTTON1DOWN message contains the pixel coordinates of the mouse pointer relative to the lower-left corner of the window. TAQUIN uses the MOUSEMSG macro to extract these coordinates. The *x*- and *y*-coordinates are divided by *cxSquare* and *cySquare*, and the results are stored in *sMouseCol* and *sMouseRow*. These values represent the column and row position of the square under the mouse pointer.

TAQUIN then applies validity checks to the *sMouseCol* and *sMouseRow* values. The mouse pointer must be positioned over a square in the same column or the

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same row as the blank square, but not over the blank square itself. WM_BUTTON1DOWN processing is aborted with a break statement if the position is invalid.

When the user clicks on a square, the values in the *asPuzzle* array must be shifted around somewhat, which is the purpose of the four *for* loops. At this point, part of the client window must be redrawn, reflecting the new position of the squares. Rather than paint the window immediately, however, TAQUIN sets the fields of *rcl* (the RECTL structure) to the coordinates of the rectangle that must be repainted. This area is then invalidated by a call to WinInvalidateRect, which causes a WM_PAINT message to be placed in the program's message queue. The window is then updated somewhat later, after the WM_PAINT message has been retrieved from the message queue.

WM_CHAR: KEYBOARD INTERFACE

TAQUIN also provides a keyboard interface that uses the cursor arrow keys. Keyboard input is delivered to a program in the form of WM_CHAR messages. To avoid reduplicating the square-moving logic built into the processing of WM_BUTTON1DOWN, the WM_CHAR message is translated into an equivalent WM_BUTTON1DOWN message. Thus, pressing the down arrow key is the same as clicking on the square above the blank square.

The CHARMSG macro is used to obtain information encoded in the *mp1* and *mp2* message parameters. TAQUIN checks for four virtual-key codes for the four arrow keys and sets the values of *sMouseCol* and *sMouseRow* to the coordinates of a square that, if clicked, is equivalent to the key pressed. The window procedure then sends itself a WM_BUTTON1 DOWN message, which is processed normally.

WM_COMMAND: MENU SELECTIONS

Menu handling in Presentation Manager programs is usually fairly simple. You'll recall that in the last issue, we defined a menu template in the TAQUIN.RC resource script file. All the mouse and keyboard input to the menu is handled within the Presentation Manager. After the user makes a menu selection, the menu window posts a WM_COMMAND message to the client window.

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In processing the WM_COMMAND message, ClientWndProc uses the COMMANDMSG macro to determine which menu item was selected. The *cmd* field associated with COMMANDMSG may be IDM_NORMAL, IDM_INVERT, IDM_SCRAMBLE, or IDM_ABOUT. These are the four identifiers defined in TAQUIN.H and used in the definition of the menu template in TAQUIN.RC.

For the IDM_NORMAL and IDM_INVERT identifiers, which correspond to the Normal Reset and Inverted Reset menu options, TAQUIN simply initializes the *asPuzzle* array, the *sBlankRow* and *sBlankCol* variables, and invalidates the entire window (which drops a WM_PAINT message into the program's message queue). For IDM_INVERT, the last two numbered squares are switched around.

For the IDM_SCRAMBLE identifier (the Scramble menu option), TAQUIN simulates random mouse clicks by sending WM_BUTTONIDOWN messages. This scrambles the arrangement of the squares. This takes a little time, so TAQUIN displays the SPTR_WAIT (the hourglass) mouse pointer before it begins and restores the SPTR_ARROW mouse pointer when it's through.

During the WM_COMMAND message; the WM_BUTTONIDOWN message processing makes a call to WinInvalidateRect to invalidate part of the window and put a WM_PAINT message in the program's message queue. You'll note that normally the WM_PAINT message would not be retrieved and processed until after TAQUIN had finished with the WM_COMMAND message. That's why the program calls the WinUpdateWindow function after sending the WM_BUTTONIDOWN message. This call causes the WM_PAINT message to be processed immediately, so you can watch the squares being scrambled.

Finally, for the IDM_ABOUT identifier (which corresponds to the "About Jeu de Taquin . . . " menu item) TAQUIN calls WinDlgBox to display a dialog box based on the dialog box template in the TAQUIN.RC file identified by IDD_ABOUT. The dialog box window procedure is AboutDlgProc, the last function in TAQUIN.C. The AboutDlgProc function simply waits until the OK button is pressed or the user presses the Esc key.

Apart from the fun of playing it, TAQUIN is a good example of why programmers like to use games to work out the problems involved in writing for a graphical interface. Besides, programming a puzzle like this lets you decide whether to be a nice guy or not. In invoking the Scramble option, for example, it would have been easy to randomize whether or not the final result would be soluble. But I'm a softie. If you scramble starting with a soluble ("Normal") screen, the result will be soluble. If you scramble an "Inverted" screen, however, you'll have to beat Sam Loyd and the laws of mathematics to win.

If you have any questions about TAQUIN, you can ask me in the Programming Forum of PC MagNet. Don't hesitate to ask. With a system as new as the Presentation Manager, we are all newcomers. ■

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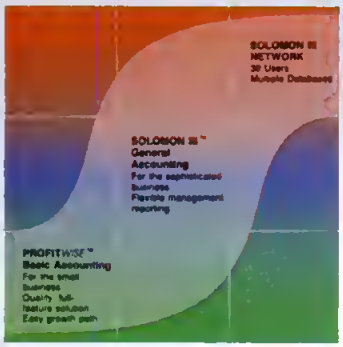

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CIRCLE 747 ON READER SERVICE CARD

by
Ray Duncan

Power Programming

Heaps are very dear to C programmers, especially to those with machines (Macintoshes, Amigas, and Ataris, for example) that have sophisticated, ROM-based memory management routines that you can take for granted. IBM PC assembly-language programmers, on the other hand, are likely to exhibit a classic fight-or-flight syndrome when you start talking about heaps. Instinctively, the assembly language programmer fears that data in a heap will float about frivolously in memory, jeopardizing the programmer's total power over the placement of every bit.

In fact, heaps are not all that mysterious, complex, or dangerous. As the term is commonly used today, a *heap* is simply an area or pool of memory that can be subdivided on demand into smaller blocks. The procedures that allocate, resize, and release chunks of memory from a heap are collectively called the *heap manager*.

Note that, among computer scientists, *heap* has a much more specific, specialized meaning. In this more restricted sense, it refers to a tree data structure in which the key in each node is larger than (or the same size as) the keys of all its child nodes. Simple, elegant algorithms have been worked out for inserting, deleting, replacing, and sorting the contents of such heaps. (See, for example, chapter 11 of Robert Sedgewick's *Algorithms*, 2nd edition.) For our purposes here, we'll ignore these classic heaps and use the word in its more mundane sense.

Using heaps isn't restricted to C programming. With the heap manager you can save memory while adding elegance and flexibility to assembly language programs.

TWO TYPES OF HEAPS

When you're programming in C or in other high-level languages (HLL) under MS-DOS or OS/2, there are actually two different heaps to consider: the global heap and the local heap. The *global heap* is the entire area of dynamically allocatable memory administered by the operating system. The program's code, data, and stack all reside in blocks of memory that are allocated from the global heap by the system loader. The program can allocate additional memory from the global heap by using appropriate operating system function calls, as shown in Figure 1.

The local heap is an area of memory in the program's near data segment (DGROUP). This heap is administered by procedures that are linked into the program from the HLL's runtime library. By convention, the local heap is located above the program's variable data, static data, and stack, and it can grow until the total size of the data segment is 65,536 bytes (see Figure 2). The key points about the local heap are that objects within it can be addressed with near pointers and that allocating or releasing such objects does not require a call to the operating system. In consequence, access to the local heap is relatively fast.

There are three reasons why HLLs have local heaps: (1) to minimize the need for statically allocated variables, arrays, and other structures; (2) to defeat the language's scoping rules for data; and (3) to avoid stack overflows from the allocation of automatic data objects. (Scoping rules control whether a data item declared in one routine can be referenced by name in another procedure. Automatic variables and structures are created on the stack during the execution of a procedure and disappear when the procedure exits.)

Consider, for example, the common situation in which a program must read a 4K configuration file into memory during execution of its initialization procedure. The program certainly doesn't want to declare a 4K static buffer for this purpose. To do so would mean that, unless special pains were taken to map buffers required by other procedures onto the same memory addresses, the 4K would simply become dead space in the data segment after the program initialization was completed. On the other hand, the program doesn't want to allocate a 4K buffer as an automatic array on the stack, either. That's because a 4K stack is much larger than most programs need, and (again) the excess stack space would simply be wasted for the remainder of the program's execution.

A sensible solution in this case, then, is to allocate a 4K buffer from the program's local heap for as long as it is needed, then to release the buffer back to the heap's free space before the end of the initialization procedure. That way, the 4K of memory is made available for reuse throughout the duration of the program's execution and can be reallocated in whatever size chunks are required by the program's other procedures. The 1K or 2K overhead required by the heap manager routines is more than repaid by the ability to use and reuse the precious free memory in the near data segment efficiently.

HEAP MANAGEMENT IN C

If you're programming in C, the standard heap management functions are `malloc()`, `realloc()`, and `free()`. These are the three functions that you should stick to in your programs if you want the programs to be portable between memory models and CPU architectures.

The sole parameter of `malloc()` is a size (in bytes). The function returns a pointer to an allocated block of memory. (It returns a NULL pointer if a block of the requested size cannot be allocated.) The

realloc() function accepts a pointer to an existing block and a new size (in bytes), and it returns a pointer—which may not be the same as the original pointer if the heap manager was forced to move the block in order to expand it. The function free() accepts a pointer to a previously allocated block and releases that block to the heap's free space; it returns nothing.

All three functions—malloc(), realloc(), and free()—deal in pointers of type void. In order to help the C compiler detect logical bugs in your code, it is wise to typecast the pointers returned by malloc() and realloc(), then assign them to pointer variables of the intended type. For example, to allocate a 256-integer array from the heap dynamically, you might write the following:

```
int *myarray;
myarray = (int *)
  malloc(sizeof(myarray[0]) * 256);
```

You can then address the allocated array with the usual notation: myarray[0], myarray[1], and so on, ignoring the fact that the array is actually being addressed indirectly with the pointer variable.

Does malloc() use global or local heaps? The answer depends on which memory model you have adopted. If you are using the small or medium model, each of which has only one data segment, malloc() allocates from the local heap and returns near pointers. If you are programming with the compact, large, or huge model, on the other hand, malloc() allocates from the global heap. In these cases, it uses the operating system's functions to allocate memory and returns a far pointer.

If you're willing to trade portability for flexibility, you can delve into your C compiler's runtime library manual and make use of the nonstandard functions related to heap management you'll find there. For example, you can force allocation from the local heap by using _nmalloc() or from the global heap by using _fmalloc(). There are also functions to obtain or change the total size of the heap, to find the size of the largest block of free memory in the heap, to check the heap for integrity and consistency, and so on.

There are two special pitfalls to avoid when you use the C runtime library's heap manager. The first is memory leaks. These are blocks that your program allocates but then fails to free when they are no longer needed. The most common culprit here is unstructured code—procedures with multiple exit points or go-tos. Memory leaks are extremely important bugs to detect and fix. Otherwise, if your program executes long enough, the heap will eventually fill up and the program will fail unexpectedly.

The other problem to watch out for is hidden calls to malloc() that may be made by other C library routines. A perfect example of this is fopen(), which in most implementations calls malloc() to obtain memory for a structure used to control the file. Again, if (because of logical bugs or unstructured code) your program repeatedly calls fopen() without a corresponding fclose() operation, the free memory in the heap will eventually be exhausted and your program will bomb.

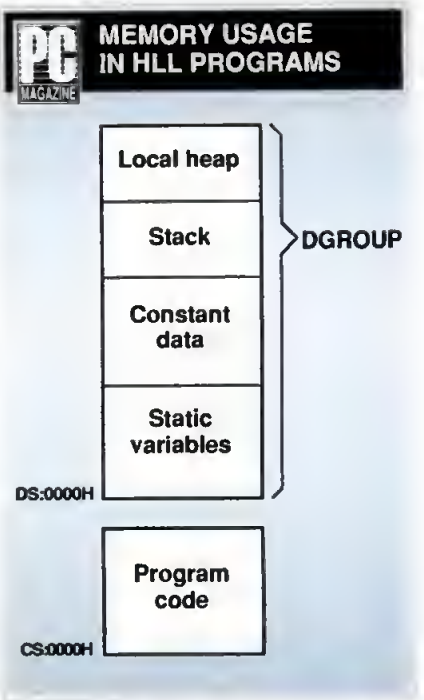

Figure 2: In the layout shown above for a typical program written in a high-level language (HLL), note that the stack and the local heap are located at the top of the program's near data segment (DGROUP). The stack grows downward toward the static constants and variables, while the heap grows upward toward the end of the segment.

GLOBAL HEAP ALLOCATION FUNCTIONS

MS-DOS Int 21h function	Description	OS/2 function
48h	Allocate memory block	DosAllocSeg or DosAllocHuge or DosAllocShrSeg
49h	Release memory block	DosFreeSeg
4Ah	Resize memory block	DosReallocSeg or DosReallocHuge

Figure 1: The operating system function calls for controlling the global heap under MS-DOS and OS/2 are shown in the table above. The MS-DOS calls work in terms of "paragraph" or "segment" addresses; for example, physical memory addresses divided by 16. The OS/2 calls accept or return protected-mode "selectors" that represent the physical address of the block indirectly (the physical address is not known to the application).

HEAPS IN ASSEMBLY LANGUAGE

Most assembly language programmers are in the habit of statically allocating all of their data items. But the arguments against this practice are no less valid for assembly language programs than for those written in C. You can make your programs considerably more elegant, flexible, and compact by adding a simple heap manager to your assembly language bag of tricks. The source listing for HEAP.ASM (Figure 3) will serve as a simple example of the techniques and issues involved.

HEAP.ASM works on the near data segment (that is, on the segment addressed by register DS), accepting and returning pointers that are offsets from DS. HEAP.ASM contains four public routines: HINIT, HALLOC, HREALLOC, and HFREE. (Other procedures in the file are local subroutines and should not be called directly by an application.) All four routines indicate an error by returning with the

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HEAP.ASM 1 of 2

```
        title   HEAP.ASM  Simple MASM Heap manager
        page    55,132

; HEAP.ASM --- Simple Heap Manager for MASM Programs
; Copyright (C) 1989 Giff Davis Communications
; PC Magazine * Ray Duncan
;
; To trade safety for speed, change the CHKPTRS equates.
;
; The routines in this module all assume that the
; CPU direction flag is clear!!

true    equ     -1
false   equ     0

chkptrs equ     true                    ; if true, HREALLOC and
                                        ; HFREE check all pointers

DGROUP  group   _DATA

_DATA   segment word public 'DATA'

hbase   dw      0                       ; base address of heap
hsize   dw      0                       ; size of heap

_DATA   ends


_TEXT   segment word public 'CODE'

        assume  cs:_TEXT,ds:DGROUP

;
; HINIT:        initialize local heap
;
; Call with:    AX      = size in bytes
;               DS:HX   = address of heap base
;
; Returns:      If function successful,
;               Carry   = clear
;
;               If function failed
;               Carry   = set
;
        public  hinit
hinit   proc    near

        cmp     ax,2                    ; check heap size
        jbe     hinit1                  ; too small, return error
        cmp     ax,32768
        jae     hinit1                  ; too big, return error

        push    ax                      ; save registers
        push    bx

        mov     hsize,ax                ; save heap size
        mov     hbase,bx                ; save heap base address
        sub     ax,2                    ; create header for block
        mov     [bx],ax                 ; containing all free space
        inc     ax
        add     bx,ax                   ; set Carry if segment wrap

        pop     bx                      ; restore registers
        pop     ax
        ret                             ; return to caller

hinit1: stc                             ; bad parameter,
        ret                             ; return Carry = set

hinit   endp

;
; HALLOC:       allocate block from local heap
;
; Call with:    AX      = requested block size
;
; Returns:      If function successful
;               Carry   = clear
;               DS:AX   = address of allocated block
;
;               If function unsuccessful
;               Carry   = set
;
        public  halloc
halloc  proc    near

        call    hfind                   ; try and allocate block
        jnc     hall                    ; jump if block was found

        call    hconl                   ; coalesce free blocks
        call    hfind                   ; try again to allocate

hall:   ret                             ; return to caller

halloc  endp

;
; HREALLOC:     resize previously allocated block
;
; Call with:    AX      = new requested block size
;               DS:BX   = address of existing block
;
; Returns:      If function successful
;               Carry   = clear
;               DS:BX   = address of resized block
;
;               If function unsuccessful
;               Carry   = set
;
        public  hrealloc
hrealloc proc   near

        push    ax                      ; save registers
        push    cx
        push    si
        push    di
        push    es

        if      chkptrs
        call    hvalid                  ; check if valid pointer
        jnc     hreal1                  ; pointer is OK
        jmp     hreal6                  ; bad pointer, exit
        endif

hreal1: mov     cx,ax                   ; save new requested size
        mov     si,bx                   ; save block base address
        mov     di,hbase                ; get address of heap end
        add     di,bsize
        mov     es,[si-2]               ; get current block size
        and     ax,7fffh                ; remove in-use bit
        cmp     cx,ax                   ; is block growing?
        ja      hreal2                  ; yes, jump
        je      hreal5                  ; no size change, exit

        sub     ax,cx                   ; block shrinking, find excess
        cmp     ax,2                    ; enough for another header?
        jb      hreal5                  ; no, leave block alone

        mov     [si-2],cx               ; shrink existing block
        or      word ptr [si-2],8000h   ; and set in-use bit
        add     si,cx                   ; create new block to hold
        sub     ax,2                    ; the excess memory
        mov     [si],ax
        jmp     hreal5                  ; now exit

hreal2: call    hcon1                   ; coalesce free blocks

        add     si,ax                   ; get addr. of next block
        cmp     si,di                   ; reached end of heap?
        je      hreal4                  ; yes, jump

        test    word ptr [si],8000h     ; next block free?
        jne     hreal4                  ; no, must try elsewhere
        add     ax,[si]                 ; yes, are combined blocks
        add     ax,2                    ; large enough?
        cmp     cx,ax
        ja      hreal4                  ; no, jump

        mov     [bx-2],cx               ; update block header and
        or      word ptr [bx-2],8000h   ; set in-use flag

        sub     ax,cx                   ; find excess memory
        cmp     ax,2                    ; large enough for header?
        jb      hreal3                  ; no, jump

        mov     si,bx                   ; create header for block
        add     si,cx                   ; containing excess memory
        sub     ax,2
        mov     [si],ax
        jmp     hreal5                  ; now exit

hreal3: add     ax,cx                   ; excess is 0 or 1 bytes,
        mov     [bx-2],ax               ; fold it into the block
        or      word ptr [bx-2],8000h
        jmp     hreal5                  ; now exit

hreal4: mov     ax,cx                   ; look elsewhere for
        mov     si,bx                   ; sufficiently large block
        call    hfind
        jc      hreal6                  ; none available, exit

        and     word ptr [si-2],7fffh   ; mark old block available
        mov     cx,[si-2]               ; get its length for move
        mov     di,bx                   ; copy old block to new
        push    ds
        pop     es
        rep movsb

hreal5: clc                             ; successful reallocation,
                                        ; return Carry = clear

hreal6: pop     es                      ; restore registers
        pop     di
        pop     si
        pop     cx
        pop     ax
        ret                             ; return to caller

hrealloc endp

;
; HFREE:        release heap block
;
; Call with:    DS:BX   = block pointer
;
; Returns:      If CHKPTRS is FALSE
;               Nothing
;
;               If CHKPTRS is TRUE and pointer valid
;               Carry   = clear
;
;               If CHKPTRS is TRUE and pointer invalid
;               Carry   = set
```

Figure 3: Shown above is HEAP.ASM, the source code listing for a simple heap manager for assembly language programs.

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HEAP.ASM 2 of 2

```
;
        public  hfree
hfree   proc    near

        if      chkptrs
        call    hvalid                  ; check if valid pointer
        jc      hfree1                  ; jump if bad pointer
        endif

        and     word ptr [bx-2],07fffh  ; turn off in-use flag
hfree1: ret                             ; back to caller

hfree   endp

;
; HFIND:        private subroutine for HALLOC and HREALLOC,
;               finds a free block in heap
;
; Call with:    AX      = requested block size
;
; Returns:      If function successful
;               Carry   = clear
;               DS:BX   = address of allocated block
;
;               If function unsuccessful
;               Carry   = set
;
hfind   proc    near

        push    ax                      ; save registers
        push    bx
        push    si
        push    di

        mov     cx,ax                   ; save requested block size
        mov     si,hbase                ; get heap base address
        mov     di,si
        add     di,hsize                ; get address of heap end

hfind1: lodsw                           ; pick up next block header
        or      ax,ax                   ; this block free?
        js      hfind2                  ; not free if bit 15 set, jump
        cmp     ax,cx                   ; block free, large enough?
        jae     hfind4                  ; size is adequate, jump
hfind2: and     ax,07fffh               ; go to next block
        add     si,ax
        cmp     si,di                   ; end of heap reached?
        jne     hfind1                  ; not yet, try next block

hfind3: stc                             ; couldn't allocate block,
        jmp     hfind7                  ; return Carry = set

hfind4: mov     bx,si                   ; save block base in BX
        je      hfind8                  ; jump if exactly right size

        sub     ax,cx                   ; find excess amount
        cmp     ax,2                    ; enough for another header?
        jae     hfind5                  ; yes, jump

        add     ax,cx                   ; no, skip this block
        jmp     hfind2

hfind5: add     si,cx                   ; subdivide existing block
        sub     ax,2                    ; create header for free block
        mov     [si],ax                 ; containing excess memory

hfind8: or      cx,8000h                ; set block size and in-use
        mov     [bx-2],cx               ; flag, else clear Carry

hfind7: pop     di                      ; restore registers
        pop     si
        pop     cx
        pop     ax
        ret                             ; return to caller

hfind   endp

;
; HCOAL:        private subroutine for HALLOC and HREALLOC,
;               coalesces adjacent free blocks in heap
;
; Call with:    nothing
;
; Returns:      nothing
;
hcoal   proc    near

        push    ax                      ; save registers
        push    bx
        push    si
        push    di

        mov     bx,hbase                ; get heap base address
        mov     di,bx
        add     di,hsize                ; get heap end address

hcoal1: mov     si,bx                   ; point to block header

hcoal2: lodsw                           ; get length from header
        mov     bx,ax                   ; calc. address of next block
        and     bx,7fffh
        add     bx,si
        cmp     bx,di                   ; end of heap reached?
        je      hcoal3                  ; yes, exit

        or      ax,ax                   ; not last block, is it free?
        js      hcoal1                  ; not free if bit 15 set, jump

        test    word ptr [bx],8000h     ; next block free also?
        jns     hcoal1                  ; no, jump

        add     ax,[bx]                 ; merge two blocks together
        add     ax,2
        sub     si,2
        mov     [si],ax                 ; update header of 1st block
        jmp     hcoal2                  ; try for another merge

hcoal3: pop     di                      ; restore registers
        pop     si
        pop     bx
        pop     ax
        ret                             ; return to caller

hcoal   endp

        if      chkptrs
;
; HVALID:       tests whether a heap pointer is valid
;
; Call with:    DS:BX   = questionable pointer to block
;
; Returns:      If pointer is valid
;               Carry   = clear
;
;               If pointer is invalid
;               Carry   = set
;
        public  hvalid
hvalid  proc    near

        push    ax                      ; save registers
        push    si
        push    di

        test    word ptr [bx-2],8000h   ; make sure already allocated
        je      hval2                   ; no, pointer invalid

        mov     si,hbase                ; get heap base address
        mov     di,si
        add     di,hsize                ; get heap end address

hval1:  lodsw                           ; get length of this block
        cmp     si,bx                   ; do pointers match?
        je      hval3                   ; yes, jump (carry is clear)
        and     ax,7fffh                ; strip in-use bit and
        add     si,ax                   ; advance to next block
        cmp     si,di                   ; end of heap?
        jne     hval1                   ; no, try again
hval2:  stc                             ; end of heap, pointer invalid

hval3:  pop     di                      ; restore registers
        pop     si
        pop     ax
        ret                             ; return to caller

hvalid  endp
        endif

_TEXT   ends

        end
```

carry flag set. They signal success by clearing the carry flag.

Your program must call HINIT during its initialization sequence, supplying the base address (as an offset from DS) and the size (in bytes) of the area the heap manager can use for its memory pool. In the simple implementation shown here, the maximum block size that can be allocated from the heap is 32,767 bytes. (The reason for this restriction will be seen shortly.) Your program can then call HALLOC to allocate blocks of memory, HREALLOC to resize previously allocated blocks, and HFREE to release blocks back to the heap.

The operation of this heap manager is very straightforward. Each allocated or available block of memory in the heap is preceded by a header word that gives the size of the block in bytes. The blocks are thus implicitly chained together, and the end of the chain is also implicit from the base address and the length originally provided to HINIT. The most significant bit of a block's header word is clear if the block is available; it is set if the block is allocated. (That's why any particular block cannot be larger than 32,767 bytes.)

When HALLOC is called to allocate a new block, it scans down through the memory pool, leaping from one block to another by the size field, until it finds an unassigned block large enough to satisfy the request. If the block that is found is larger than the one requested, the block is subdivided and the excess becomes a new

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unassigned block. If no suitable block is found, HALLOC makes another pass through the heap—trying to combine adjacent free blocks to create one large enough for the request—before giving up.

HREALLOC is used to resize a block previously allocated with HALLOC. If the new requested size is smaller than the old one, the block is subdivided and the excess becomes an unassigned block. If the new size is larger than the old one, HREALLOC first attempts to get the additional space from the subsequent block (if it is not allocated). Otherwise, HREALLOC searches the rest of the heap for a block of sufficient size, copies the previous block to the new one, and releases the original.

The HFREE routine is the simplest of the four. It is called with a pointer and it returns nothing. Its only action is clearing the bit in the header word that precedes the actual memory block, making the block available. Free blocks in the heap are not combined during the execution of HFREE: it would be wasted execution time if the collected free space was never needed.

You can modify the "chkptrs" equate in the source listing if you want to trade speed for error checking in the heap management routines. During development of an application that uses HEAP.ASM, set chkptrs to "true" so that each pointer that is fed to HREALLOC or HFREE is validated before the associated memory block is resized or released. After your application is debugged, set chkptrs to "false" so that the heap management routines run at the fastest possible speed.

A simple demonstration program, TRYHEAP.ASM, lets you interactively allocate, resize, and release blocks using the routines in HEAP.ASM. After each command, TRYHEAP walks through the heap and displays the address, size, and status of each allocated and available block. The source listing for TRYHEAP is not printed here, but both MS-DOS and OS/2 versions of the program are available for downloading from PC MagNet. ■

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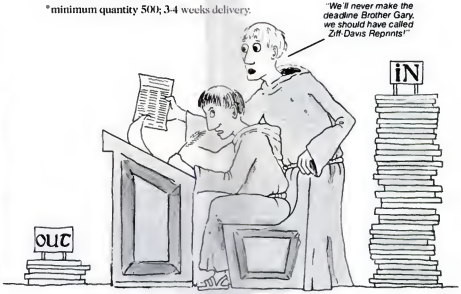

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by
Douglas Cobb
and Steven Cobb

Spreadsheet Clinic

SERIAL DATE VALUES IN SUPERCALC

In the January 31, 1989, issue, you presented a *1-2-3* macro that will calculate the serial date value of the final day of a month. This macro used a formula that was in the form

```
@IF(@MONTH(cell)=11,
@DATE(@YEAR(cell)+1,1,1)-1,
@IF(@MONTH(cell)=12,
@DATE(@YEAR(cell)+1,2,1)-1,
@DATE(@YEAR(cell),@MONTH(cell)
+2,1)-1))
```

where *cell* is a reference to a cell that contains the serial date value of the final day of the previous month. Then, in a later issue, you pointed out that the much shorter formula

```
+cell+32-@DAY(cell+32)
```

performs the same calculation.

I have since found that as long as I allow for the difference between the *1-2-3* and *SuperCalc* date functions, I can use this same formula in *SuperCalc 4*. Specifically, if I wanted to calculate the final day of the next month in *SuperCalc*, I would use the formula

```
DATE(MONTH(cell)+2,0,YEAR(cell))
```

where *cell* is a reference to a cell that contains the serial date value of the previous month.

For example, you could use the function

```
DATE(MONTH(A1)+2,0,YEAR(A1))
```

to calculate the serial date value of the last day of the month that follows the date in cell A1 (which itself should be the final day of a month). If cell A1 in the worksheet contains the serial date value of June 30, 1989, this function will return the serial date value of July 31, 1989.

Tom L. Cox
Incline Village, Nevada

- **SERIAL DATE VALUES IN SUPERCALC: A 1-2-3 formula that calculates a date series to SuperCalc.**
- **CREATING AN AUDIT TRAIL: A clever macro that simulates the paper tape of an adding machine for calculations in 1-2-3.**
- **GENERATING A SERIES OF WEEKDAY DATES: This technique works with 1-2-3, Quattro, and VP-Planner.**
- **DUPLICATING /RANGE JUSTIFY: Simulating a useful 1-2-3 function in Microsoft Excel.**

PC MAGAZINE

Unlike *1-2-3* and *Quattro*'s @DATE functions, *SuperCalc*'s DATE function accepts month arguments greater than 12 (or less than 1); it also accepts day arguments that are either less than 1 or exceed the maximum number of days in the month. For example,

```
DATE(13,1,89)
```

returns the serial date value of January 1, 1990, the first day of the first month of the following year. Similarly, the function

```
DATE(7,0,89)
```

returns the serial date value of June 30, 1989, the final day of the previous month.

Microsoft Excel's DATE() function also accepts "illegal" arguments. Consequently, you can use a function in the form

```
=DATE(YEAR(cell),MONTH(cell)+2,0)
```

to calculate the serial date value of the final day of the next month, if *cell* contains the serial date value of the final day of the previous month. (Note that the order of the arguments differs from that of the *SuperCalc* DATE function.)

You can use similar functions to calculate the serial date value of the first day of a month, given the serial date value of the first day of the previous month. In *SuperCalc*, you would use the function

```
DATE(MONTH(cell)+1,1,YEAR(cell))
```

In *Excel*, you would use the function

```
=DATE(YEAR(cell),MONTH(cell)+1,1)
```

The function

```
+cell+32-@DAY(cell+31)
```

performs this calculation in *1-2-3* and *Quattro*.

CREATING AN AUDIT TRAIL

I often add up lists of numbers using an adding machine so that each value is printed on a paper tape. The tape provides an audit trail, letting me go back and check for keying errors.

Recently, I developed a *Lotus 1-2-3* macro, shown in Figure 1, that simulates the action of a paper tape adding machine. Each time you type a value and press the Enter key, *1-2-3* enters it into the current cell and then moves the cell pointer down one cell. If you press the Enter key without typing a number first (that is, if you press that same key two times in a row), the *1-2-3* program will total the values you have entered as a paper adding machine would.

The first statement tells the macro to pause until you press Enter. During the pause, you type a value—preferably on the numeric keypad. As soon as you press Enter, *1-2-3* will end the pause and press the Enter key, locking the value that you just typed into the current cell.

The next statement in this macro tests to

see whether or not the current cell is empty. If it's not empty (that is, if you have made an entry), *1-2-3* will move the cell pointer down one cell, then branch back to the beginning of the macro and wait for you to type another value.

If you press Enter without typing anything first, the {If} statement in cell B2 will be false. *1-2-3* will skip the remaining commands in cell B2 and execute the statement in cell B3. This last statement commands *1-2-3* to enter a formula into the current cell that sums the values you have entered up to that point. Since cell B4 is blank, *1-2-3* will end the execution of the macro at this point.

A. DeSouza
Houston, Texas

This macro is both useful and clever. If you wish, you can modify it as shown in Figure 2. As you can see, we've inserted the statement

```
B2: '{If @CELLPOINTER("type")="l"}
    {Beep}/re~{Branch \a}
```

between cells B1 and B2 of the original macro. This statement causes *1-2-3* to beep, erase the current cell, and then branch to the beginning of the macro if the user types a label instead of a value.

We've also entered the statements

```
B5: '{Get CHAR}
B6: '{If CHAR="e"}{Branch \e}
```

assigned the name CHAR to cell B8, entered the statement

```
B9: '/re.{End}{Up}~
```

and assigned the name \e to that cell.

Now after the statement in cell B4 sums the values that you entered into the worksheet, the statement in cell B5 commands *1-2-3* to pause until you press any key. When you do, *1-2-3* will enter the macro representation of the key you pressed into the cell named CHAR (B8). If you pressed the e key, the {If} command at the beginning of cell B6 will be true. In this case, *1-2-3* will branch the execution of the macro to the cell named \e (B9). The statement in this cell erases the values that you entered, plus the sum that follows them. At this point, *1-2-3* will end the execution of the macro. If you press any key other than e, *1-2-3* will end the macro without erasing the "tape." However, you can erase the tape by pressing Alt-E. (Before you do, make sure the cell pointer is on the cell that contains @SUM).

GENERATING A SERIES OF WEEKDAY DATES

I use *VP-Planner Plus* to track various stock market indicators. Most of my spreadsheets have a date column that includes only weekdays—the days that the financial markets are open. To generate a series of weekday dates, I use the following technique:

First, I enter an @DATE function that returns the serial date value of the starting date into the cell in which I want the series to begin. Then, I enter a function in the following form:

```
@IF(@MOD(cell,7)<6,cell+1,cell+3)
```

into the next cell below, where cell is the address of the cell that contains the date.

A user-defined function in *Excel* will emulate *1-2-3*'s /Range Justify.

Then I copy this function down into the remaining cells of the range that I want to fill.

For example, suppose you want to fill cells A1..A10 with a series of the serial date values of the first 10 weekdays in May 1989. First, enter the function `@DATE(89,5,1)` into cell A1. It will return the value 32629—the serial date value of Monday, May 1, 1989. Next, enter the function `@IF(@MOD(A1,7)<6,A1+1,A1+3)` into cell A2. Finally, copy that function into cells A3..A10.

John C. Wainwright
Riverview, Michigan

This technique works in *1-2-3* and *Quattro* as well as in *VP-Planner*. Dividing the serial date value of any date that falls on a Monday, Tuesday, Wednesday, or Thursday by 7 leaves a remainder of 2, 3, 4, and 5, respectively. Adding 1 to the serial value of any of those dates produces the serial value of the next weekday. However, dividing the serial date value of any Friday by 7 leaves a remainder of 6. To produce the serial date value of the next weekday after a Friday, you have to add 3.

Unfortunately, this technique will not work properly if you enter the serial value of a weekend day into the first cell of the range. To make sure that errors of this sort are brought to your attention, modify the

1-2-3 MACRO — **COMPLETE LISTING**

```
     A          B          C          D          E          F          G
1    \a         {?}~
2               {If @CELLPOINTER("type")<>"b"}{Down}{Branch \a}
3               @SUM({Up}.{End}{Up})~
4
```

Figure 1: If you must add lists of numbers in *1-2-3*, this macro creates an "audit trail" against which you can check for keying errors.

1-2-3 MACRO — **COMPLETE LISTING**

```
     A          B          C          D          E          F          G
1    \a         {?}~
2               {If @CELLPOINTER("type")="l"}{Beep}/re~{Branch \a}
3               {If @CELLPOINTER("type")<>"b"}{Down}{Branch \a}
4               @SUM({Up}.{End}{Up})~
5               {Get CHAR}
6               {If CHAR="e"}{Branch \e}
7
8    CHAR
9    \e         /re.{End}{Up}~
10
```

Figure 2: This is an alternative version of the macro shown in Figure 1.

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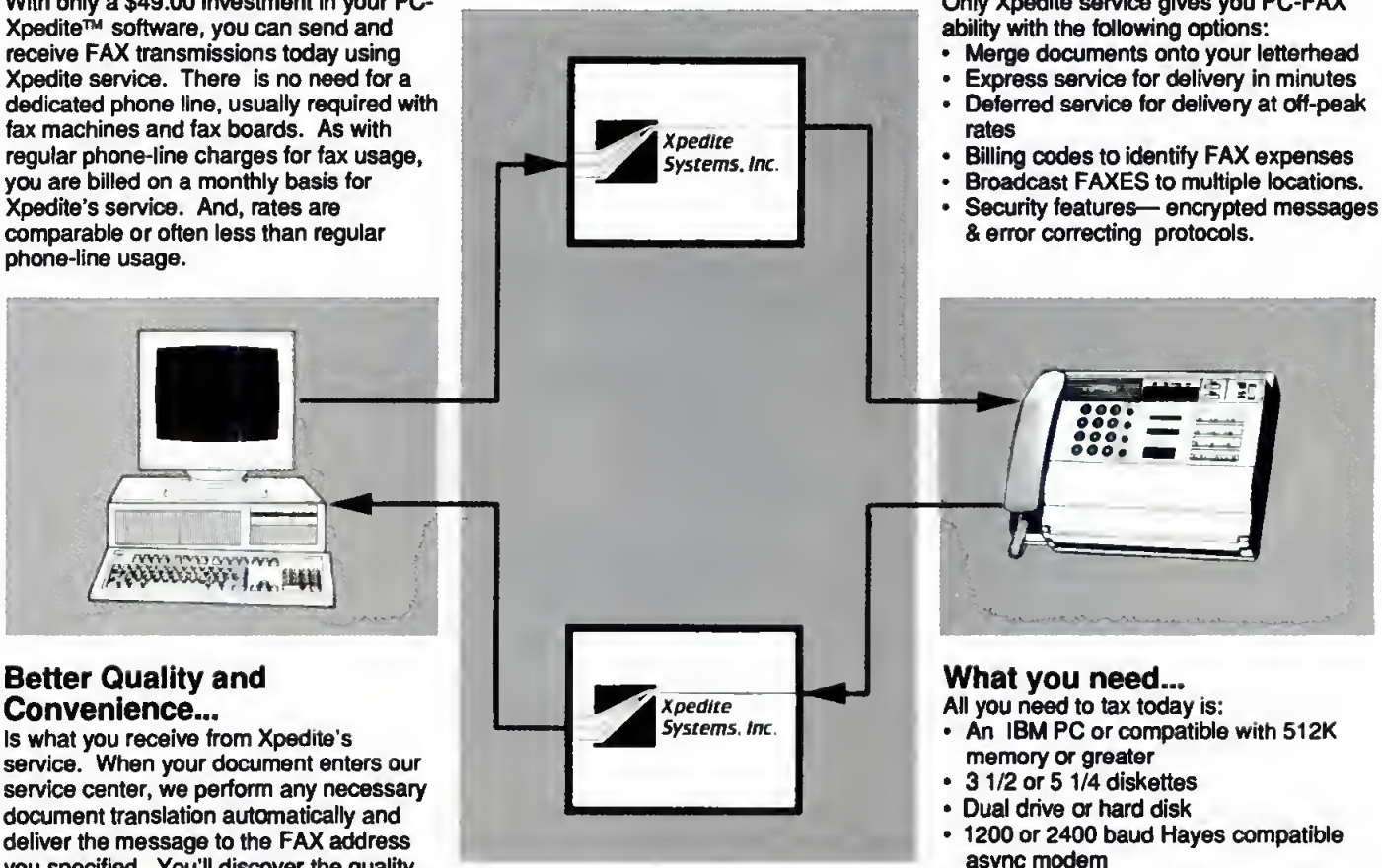

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The real cost of a network is not so much the initial price as it is the continuing outlay for maintenance–adapting it to changing needs.

That's something LANLink 5X does practically on its own. Running under PC-MOS/386™ or PC-DOS, it turns your server PC into a multi-tasking controller, driving a truly expandable LAN that is easily and quickly upgradable.

A hardware LAN, on the other hand, becomes obsolete as new technology is introduced. And, to keep the network up and running as applications change, you need the attentions of a technician, on a continuing basis. A very well-paid technician.

4. How fast can you pay for it.

Now we've arrived at the bottom line, where LANLink 5X is toughest to beat. You can install a five-user LANLink network for about the same cost as the LAN board in a board-driven network. On top of that, factor in what you save on installation and maintenance time, and the difference is pretty dramatic.

LANLink 5X is available immediately, and it comes with a money-back guarantee. Its price of $595 includes a server and a satellite module plus the network operating system. Additional satellites are available for $125.

LANLink 5X

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Spreadsheet Clinic

EXCEL FUNCTION — **COMPLETE LISTING**

```
                                A                                    B
1    TEXTWRAP
2    =RESULT(64)
3    =ARGUMENT("Text",2)
4    =SET.NAME("Rowa",ROWS(SELECTION()))
5    =IF(Rows=1,RETURN(Text))
6    =SET.NAME("Width",ROUND(LEN(Text)/Rows,0)+1)
7    =SET.NAME("Temp",A30:INDEX(A30:A16384,Rows,1))
8    =SET.NAME("RowCounter",1)
9    =SET.NAME("CharCounter",1)
10
11   =IF(RowCounter>Rows,GOTO(A24))
12   =SET.NAME("Line",MID(Text,CharCounter,Width))
13   =IF(CharCounter+LEN(Line)>=LEN(Text),GOTO(A27))
14   =IF(MID(Line,LEN(Line),1)<>" ",GOTO(A20))
15   =SET.VALUE(INDEX(Temp,RowCounter,1),Line)
16   =SET.NAME("RowCounter",RowCounter+1)
17   =SET.NAME("CharCounter",CharCounter+LEN(Line))
18   =GOTO(A11)
19
20   =SET.NAME("Line",MID(Text,CharCounter,LEN(Line)-1))
21   =IF(MID(Line,LEN(Line),1)=" ",GOTO(A15))
22   =GOTO(A20)
23
24   =SET.NAME("Width",Width+1)
25   =GOTO(A8)
26
27   =SET.VALUE(INDEX(Temp,RowCounter,1),Line)
28   =RETURN(Temp)
29
```

Figure 3: This user-defined function divides a test value into multiple parts, simulating the action of *1-2-3*'s /Range Justify command in an *Excel* worksheet.

function as shown below:

```
@IF(@MOD(cell,7)<1,@ERR,
@IF(@MOD(cell,7)<6,cell+1,cell+3))
```

Unlike the original function, this one will return the value ERR if the first date in the series is a Saturday or Sunday.

DUPLICATING /RANGE JUSTIFY

In my opinion, *Microsoft Excel* has *Lotus 1-2-3* beat hands-down in most areas. However, at least one useful *1-2-3* feature seems to be missing from *Excel*—a command that divides a long label into smaller parts. The /Range Justify command does this in *1-2-3*. How can I do this in *Excel*?

Clyde Baughman
Louisville, Kentucky

Excel does not have an equivalent for *1-2-3*'s /Range Justify command. However, the user-defined function shown in Figure 3 can divide a text value into multiple parts.

After you enter this function into a new macro sheet, pull down the Formula menu, select the Define Name command, type MDATE into the Name: text box, type =A2 into the Refers to: text box, click the Function option, and click OK.

To use this function, highlight all the cells in a single column into which you wish to divide a text value. Then, use the Formula menu's Paste Function command to place the function into the formula bar. Next, point to the cell that contains the text value you want to parse and press Ctrl-Shift-Enter to assign the function to the highlighted range.

PRODUCTIVITY TIP

To choose an item from a *1-2-3* custom menu by typing its first letter, that item must begin with an uppercase letter. If the first letter of an item is lowercase, you must point to that item and press Enter to select it.

CONTRIBUTE TO THE CLINIC

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CIRCLE 388 ON READER SERVICE CARD

by
Neil J. Rubenking

User-to-User

BATCH FILE HELP

I have a large collection of batch files. A maintenance problem I have with them is the difficulty of figuring out what they do, their proper calling syntax, and so on. One obvious though cumbersome solution is to enter REMarks into the batch file, then view these by TYPEing the file.

I've adopted the convention that a ? (question mark) used as the first argument to a batch program will produce help information. If there, the batch file ECHOes the help information; otherwise control simply skips to the body of the routine. Figure 1 contains a template for such a batch file.

Some batch routines require at least one argument and are meaningless without one. In this case a default argument may be used to list help information or to produce some other desired behavior. At the start of the batch file, I check for "no" arguments, then execute the batch file with the desired default argument(s). Note that %0 expands to the name of the batch file. Thus,

```
IF "%1"=="" %0 ?
```

would list help information, while

```
IF "%1"=="" %0 c:
```

would apply the operation (whatever it is) to the C: drive. Note that any number of default arguments may be used.

DOS 3.3 adds a CALL command to the batch vocabulary. This method of supplying a default argument might break the return stack if used within a CALLed routine.

Ken Irving
Fairbanks, Alaska

PC MAGAZINE Fortunately, there's no problem in DOS 3.3 when a CALLed batch file reruns itself. Sometimes DOS is smarter than we expect it to be. And it *is* a good idea to be able to provide some way to get a listing of correct syntax. Whenever I'm about to use a utility whose syntax I've forgotten, the first thing I try is running it with ? or /h on the command line.

- **BATCH FILE HELP: A standardized batch file Help system.**
- **CONSERVING RAM: FILES and BUFFERS take up RAM space—don't set them too high.**
- **SAVING DISK SPACE: How to save the disk space taken up by short DEBUG scripts.**
- **ELIMINATE ECHO OFF: You can suppress the appearance of ECHO OFF.**
- **CLEANING MICE: Keep your mouse clean and get better performance.**
- **PRINT.COM FORM-FEEDS: Queue up extra form-feeds with PRINT.COM.**
- **A NEW MOVE.BAT: Correction for an unfortunate error in MOVE.BAT.**

Another common practice is to have the batch file display syntax information if the user supplies improper parameters or omits required parameters. Calling this kind of batch file with ? on the command line also will get you help, unless of course ? is one of the required parameters.

CONSERVING RAM

Some applications, especially databases, will request that you set the FILES= and BUFFERS= statements in your CONFIG.SYS file to certain numbers. The higher you set these numbers—especially the BUFFERS= statement—the more memory you will use up and the less memory will be available to application programs.

I recently ran into a situation in which I had set my BUFFERS= statement higher in an attempt to fine-tune my database application. Later on, when I wanted to use my accounting program, it loaded up and promptly died.

I spent two evenings reloading my complete accounting application and even reformatting my fixed disk, only to have the problem persist. Finally I booted my computer without a CONFIG.SYS file and the problem disappeared. I reduced the number of BUFFERS and now both programs work fine.

Apparently the small increase in the BUFFERS= statement used up enough memory to crash the accounting program.

Tommy Seymour
Murfreesboro, Tennessee

BATHELP.BAT — **COMPLETE LISTING**

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```
ECHO OFF
IF NOT "%1"=="?" GOTO Start
ECHO Put help information here, including:
ECHO name, author, version, date,
ECHO calling syntax, arguments, known bugs, references, etc.
ECHO For convenience this should fit on a single screen.
GOTO End
:Start
REM Body of batch file goes here.
:End
```

Figure 1: A template for a batch file in which ? invokes help information.

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User-to-User

The FILES= line controls the number of files any process can have open at one time. By default that number is eight, but DOS uses up five of them. Each time you increase the FILES= number by one, you reduce the amount of available RAM by 48 bytes. That's not too bad, and in fact it's usually recommended that you set your system for at least FILES=20. This is the maximum that a single process can use without going through some special shenanigans, and programs that really need more than 20 will tell you so.

The BUFFERS= line controls the number of disk buffers DOS establishes. When you read data from a disk, it stays in a buffer. If you need to reread that same data, DOS can take it from the buffer rather than going to the disk again. However, every increase in the BUFFERS= number reduces the available RAM by 528 bytes, a much larger cost. If you assigned the maximum number of buffers (99 under DOS 3.3), you'd have over 50K tied up in buffers. On top of this, when you have too many buffers it can take DOS longer to look for data in the buffers than to read it from disk! The DOS 3.3 manual recommends keeping only 10 to 25.

DOS's buffers are a primitive form of disk caching. If you're using a recent disk-caching program, read the manual carefully to see if it mentions the BUFFERS= command. It will probably recommend that you reduce the DOS buffers to a very small number.

SAVING DISK SPACE

Each issue of *PC Magazine* has useful DEBUG scripts, which are saved as .SCR and .DOC files. I have found a much better way to save these little files. You can put all the information into a single file and make it very easy to create the corresponding .COM file by writing a batch file as shown below:

```
GOTO batch
{DEBUG script goes here}
{explanations go here}
:batch
DEBUG < %0.BAT > NUL
ECHO %0.COM created
```

Hans Salvisberg
Berne, Switzerland

As an example of this idea, I created WARMBOOT.BAT (see Figure 2). When you run it, it creates WARMBOOT.COM, which reboots your computer. WARMBOOT is handy in batch files that change CONFIG.SYS and require a reboot to activate the modified configuration.

I added a bit of error checking by piping the output of the DEBUG session through the FIND filter and having it count the occurrences of Error. There will always be one Error message because DEBUG doesn't like the initial GOTO Batch line. That makes it tough to automate error checking. But if more than one error is found, you need to check and correct the script.

You can take any DEBUG script and wrap it up inside a batch file like this. Add the GOTO Batch line at the start and ap-

WARMBOOT.BAT — **COMPLETE LISTING**

```
GOTO batch
N WARMBOOT.COM
A 100
MOV BX,1234
MOV AX,0040
MOV DS,AX
MOV [0072],BX
JMP FFFF:0000

RCX
11
W
Q
:Batch
ECHO OFF
DEBUG < %0.BAT | FIND /C "Error"
ECHO IF the line above contains a 1, %0.COM was created
ECHO successfully.  Otherwise, check the DEBUG script lines,
ECHO because they contain an error.
```

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Figure 2: An example of the same file as a batch file and as a DEBUG script.

Aw . . . What the Heck!

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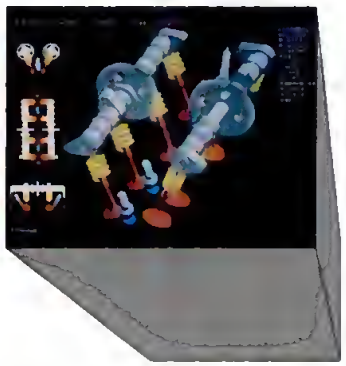

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Still don't believe us? The goblet pictured below required only 16 keystrokes and 3 commands to create! The top, front, side, and isometric views were created simultaneously . . . in less than one minute!

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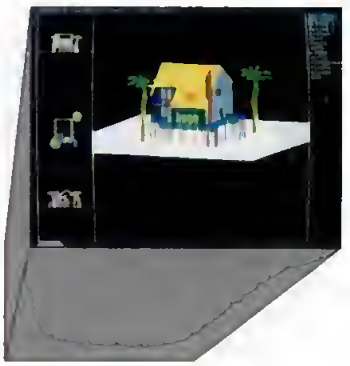
The first question asked by many people is, "Why is DesignCAD 3-D priced so low?" The answer? After developing DesignCAD 3-D version 2.D, we were unable to decide how the product should be priced. We consulted experts. We used the finest spreadsheets on the market. We took employee polls. Finally, in the great American Tradition, we said, *"Aw . . . What the Heck! Let's see the other guys best this price!"* DesignCAD 3-D version 2.0 sells for $399.



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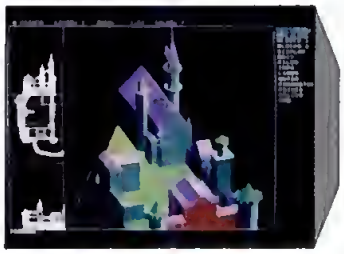

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J. TURNER, Architect, TAO Ltd. - The Woodlands, Texas

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DR. STEVENS, NASA Space Scientist/Engineer

HOW DO I GET ONE?

DesignCAD 3-D version 2.0 is available from most retail computer stores, or you may order directly from us. DesignCAD 3-D is available in a number of foreign languages from distributors throughout the world. All you need to run DesignCAD 3-D is an IBM PC Compatible and 640K RAM. DesignCAD 3-D supports most graphics cards, printers, plotters and digitizers. Free information and a demo diskette are available by contacting us at:

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pend the lines starting with :Batch to the end. Do note that the .COM file created always has the same name as the batch file, and remember that .COM files have priority over batch files. If you run WARMBOOT once, the batch file creates WARMBOOT.COM. Give the command again and you'll run the .COM file, which reboots your computer.

ELIMINATE ECHO OFF

To suppress ECHO OFF in monochrome, ^[[8m must be the first line of a batch file; this makes the screen invisible (note that ^[represents the ESCape character). An error message is generated but cannot be seen because the screen is invisible. The second line of the batch file is ECHO OFF and ECHO ^[[0m is the third line, which restores the screen.

If you need to eliminate the gap in the appearance of the screen, put the appropriate cursor positioning command in the fourth line. For example, ECHO ^[[3A (the ANSI code to move up three lines) will reposition the cursor up three lines. Of course, the ANSI.SYS driver must be installed, and you will need to look out for case sensitivity in the commands.

If you are working in color, just switch the foreground color to the background color in the first line of your batch file. If you have a blue background, for example, ^[[0;44;34m will send the foreground to blue.

Gene Feaster
Shawnee, Kansas

PC MAGAZINE Rejoice! Users of DOS versions less than 3.3 can now avoid the visible ECHO OFF at the start of each batch file. I would add CLS as a fourth line; most of my batch files start with ECHO OFF and CLS as it is.

PC Magazine's tiny editor TED.COM is especially useful for writing this kind of batch file, because you can insert the ESCape character just by pressing the Esc key. TED.COM appears in the Utilities section of the November 15, 1988, issue. You can create a file containing just the three lines described above and simply read this file into the beginning of your other batch files.

Be careful to note that this method is not completely foolproof. If your PROMPT includes ANSI color commands, the ECHO OFF line will still show up on your screen.

CLEANING MICE

Is your mouse tired? Or dragging its feet so much that the mouse pad moves instead of the mouse? A simple cleaning is all it takes to get your mouse slipping and sliding again. First, clean the felt pads on the bottom of the mouse by roughing them up a bit with your fingernail; then apply cellophane tape. Rub the tape firmly onto the felt pad with your fingernail, remove it, and repeat the process with a fresh piece of tape. Next, if you have an optical mouse, clean the surface of the metal pad with tissue moistened with rubbing alcohol. Use the same piece of tissue to clean the rubber feet on the bottom of the pad.

John M. Simpson
Eugene, Oregon

PC MAGAZINE Not all mice are created equal—some use plastic pads, some use felt, others surely use something else. Don't use the cellophane tape method

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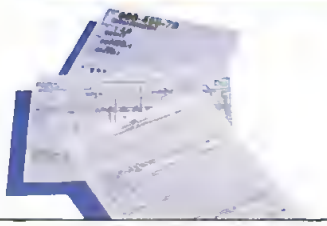

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on anything other than felt pads. But whatever kind of mouse you have, make sure to give it a good regular cleaning. All that running around on the desk makes it pick up *lots* of dust.

Many mice have a ball inside that rolls on the desk. From time to time, you should remove this ball, gently blow away any dust from its enclosure, clean the ball itself, and reinstall it.

PRINT.COM FORM-FEEDS

All the printers in my office are installed inside printer mufflers to reduce noise. While this does result in a much quieter office, it also causes the problem of having the last piece of a printout left inside the muffler. Gaining access to this last sheet requires an additional form-feed.

The fastest way I've found to cause a form-feed is to do a PRINT NUL command. This queues the NUL device to be printed. When PRINT attempts to print NUL, it will advance the paper to the top of the next form because the NUL device is empty. This is easier than keeping an empty file on your hard disk and PRINTing it.

Jim Karpinski
Ithaca, New York

Very convenient! The NUL device is always present, and PRINT .COM sends a form-feed at the end of every print job, regardless of whether there was anything to print. If you want to, you can put the extra form feeds right in the middle of a particular series of print jobs; for example,

```
PRINT FILE1
PRINT NUL
PRINT FILE2
PRINT NUL
```

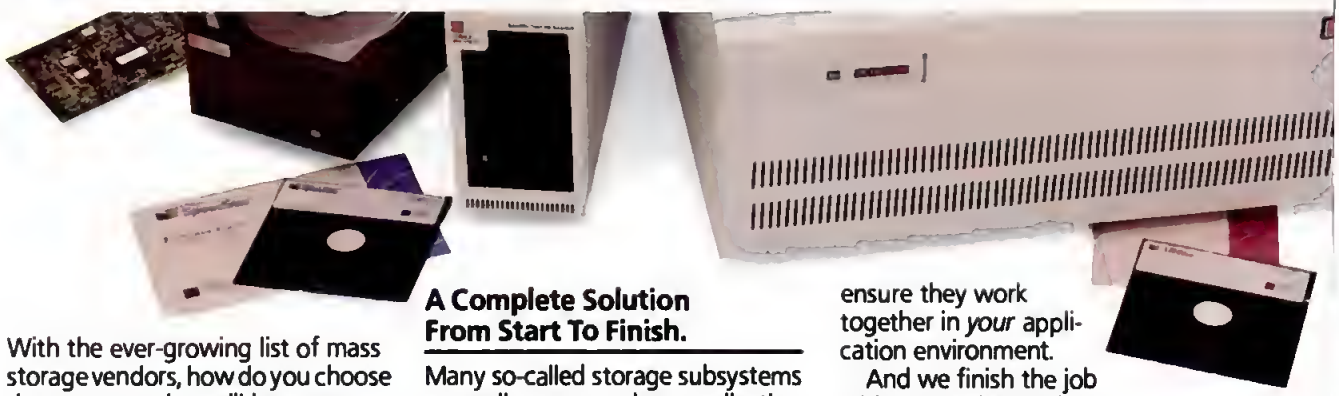
That way you'll be able to tear off the printout of each job as soon as it's finished printing.

A NEW MOVE.BAT

The March 14, 1989, issue presented MOVE.BAT, a batch program to MOVE files from place to place. The text mentions using it to move *a* file to a different directory or to a different drive. All the examples show moving a *single*, unambiguous filename. But we should have made it clear that using MOVE.BAT with wildcards is *dangerous*. If you give *.* as a parameter to MOVE.BAT, you will *totally* erase the contents of the destination directory.

The offending lines are between labels :L1 and :L2. Their purpose is to determine whether a Read-Only file of the same name already exists in the target directory. To this end, they attempt to delete that file, then check to see if it still exists. This creates no problem when the parameter is a single file, because the file in the target directory is going to be overwritten anyway. But if the parameter contains wildcards, files that aren't about to be replaced with new versions may also be deleted.

MOVE.BAT is designed to work with single, unambiguous filenames; it would take a total rewrite to make it work with wildcards. But to remove the chance of accidentally losing files by calling it with a wildcard parameter, just delete the dangerous lines. Start with the line afterlabel :L1 and delete all the way through label :L2. The modified MOVE.BAT (Figure 3) can no longer warn you if you attempt to copy



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```
ECHO OFF
IF %2'==' GOTO syntax_error
SET movepath=%3
IF %3'==' GOTO begin
SET movepath=%1\
SHIFT
GOTO begin
:syntax_error
ECHO Syntax is: MOVE [source_directory] filename destination_directory
GOTO end
:begin
IF EXIST %movepath%%1 GOTO L1
ECHO Error. Source file does not exist!
GOTO end
:L1
REM DELETE==* IF EXIST %2\%1 DEL %2\%1
REM DELETE==* IF NOT EXIST %2\%1 GOTO L2
REM DELETE==* ECHO Error. Old version could not be deleted!
REM DELETE==* GOTO end
REM DELETE==* :L2
COPY %movepath%%1 %2\%1
IF EXIST %2\%1 GOTO L3
ECHO Error. Copy unsuccessful!
GOTO end
:L3
DEL %movepath%%1
IF NOT EXIST %movepath%%1 GOTO L4
ECHO Error. Could not delete the original!
GOTO end
:L4
ECHO Succeaaful Move.
:end
```

Figure 3: This batch file fixes a dangerous side effect of MOVE.BAT.

over a Read-Only file, but it also won't delete files unexpectedly. Perhaps one of our readers will come up with a new batch file that performs the detailed checking of MOVE.BAT *and* accepts wildcards.

PC MAGAZINE PRODUCTIVITY TIP

If you run the DOS PRINT command, it will prompt you for the output device. This can be a pain if you want to run it from your AUTOEXEC .BAT file. To avoid having to answer that question, use the /D command-line switch. For example

```
PRINT /D:PRN
```

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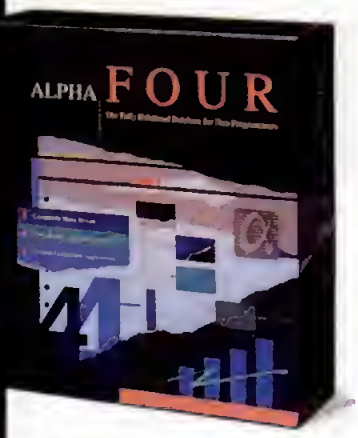

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PCM01

READER S

edited by
Craig L. Stark

Power User

A WORDPERFECT BUG

I have just come across a bug in *WordPerfect*, Versions 4.1 and 4.2. The problem appears when I type a footnote that includes the ASCII 226 character; the footnote gets garbled. After entering the 226 character, some of the note is lost, some appears in the regular text, and unexpected codes with unpredictable effects are introduced. Though I use *WordPerfect* very often, I find the above problem a handicap.

George D. Chryssos
Glyfada, Greece

PC MAGAZINE Character 226 is an uppercase gamma (Γ), and certainly a *WordPerfect* user in Greece is likely to find such a bug. It's easy enough to confirm that the bug exists: in the middle of a footnote, hold down the Alt key, tap out 2 2 6 on the numeric keypad, and release the Alt key. Finish your footnote by pressing F7. You'll immediately see that some of the footnote has appeared in the document text. Now hit Alt-F3, Reveal Codes. There's no telling what you'll see—in three tries I got three totally different results. The only thing they had in common was that all three locked up my computer.

The solution? Upgrade to Version 5.0, which doesn't have this problem. Or avoid using the uppercase gamma character in footnotes.—*Neil J. Rubenking*

CUSTOMIZING FORM LETTERS

By combining conditional commands with *Microsoft Word*'s Ask command, you can easily produce customized form letters. While mail-merging, *Word* will ask for the information to be typed at the keyboard and will insert that information when it prints. Here is an example of the format:

```
This is a paragraph that is always
included.

«Ask COMMENT=?Comment: »«IF
COMMENT »«COMMENT»

«ELSE»«ENDIF»This is another parsgraph
that is always included.
```


- A WORDPERFECT BUG: A peculiar bug in the footnote feature of WordPerfect 4.1 and 4.2.
- CUSTOMIZING FORM LETTERS: Add paragraphs to letters while mail-merging in Word.
- A PRINT PAUSE SUBSTITUTE: Build a macro to replace the Print Pause command lost in WordPerfect, Version 4.2.
- REDEFINING FUNCTION KEY COMMANDS: Customize function keys with macros in Word.
- INVISIBLE PLACE MARKERS: How to create hidden place markers and maintain page layout and printability.
- TESTING FOR POWER FAILURES: Use dBASE memory files to test for power failures during an unattended processing run.

Occasionally you will need two short paragraphs and you have made allowance for only one, as shown. Fortunately, there's an easy solution to this problem as well.

Word uses Ctrl-K (ASCII 11) as a new-line command. When editing a document, you would give the command with Ctrl + Enter. While entering text during mail-merge, however, you can get the same effect by holding down the Alt key, typing 11, and releasing the Alt key. This shows up on the screen as a little circle with an arrow attached (the symbol for Mars or male). It will "print" at the printer by starting a new line. Note that if you use the example shown above, you must enter a blank line between paragraphs and type Alt-11 twice.

William R. Mumpower
Norton, Virginia

PC MAGAZINE Readers should note that *Word* can only accept about 260 characters in response to an Ask prompt. However, Mumpower's technique works, and it can be particularly useful in an address block that is longer than you planned for. For example, you might end with City, State, ZIP code as the last line in the address and suddenly find you need a line for Country.

Also watch out for the signature block. If you have a one-page letter and add too many lines, one or two lines may be pushed to the next page, leaving "Sincerely" by itself at the bottom of the letter. You can avoid this problem by ending your last paragraph in the body of the letter with a new-line command (Shift + Enter)—rather than with a new-paragraph command—and then use new-line commands through the rest of the letter. If you format this "paragraph" as Keep Together, *Word* will move the whole block to the next page or else not move any of it at all. —*M. David Stone*

A PRINT PAUSE SUBSTITUTE

The style criteria for our office correspondence require us to put a number of print pauses in documents so we can remove various carbons from the printer. When we made the transition from *WordStar* to *WordPerfect*, Version 4.2, we lost the Print Pause command that had made this possible. Our contacts with *WordPerfect*'s phone support line yielded sympathy and understanding, but no tangible suggestions. Finally we came upon the idea of using the font change command, which causes the printer to pause for changing daisy wheels.

Though a good solution, this created an-

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Power User

other problem. We had to use two macros alternately, and the typist had to remember which one was used last. Then we came up with the idea of putting two font changes in a single macro, as shown in the example below.

```
<Ctrl-F10>          Begin macro
                    definition
<Alt-P>             Call it Alt-P
<Ctrl-F8>           Enter Print Format
                    menu
<1><CR><2><CR>      Insert Font change
                    from 1 to 2
<1><CR><1><CR>      Insert Font change
                    from 2 to 1
<CR>                Return to document
<Ctrl-F10>          End macro definition
```

With this macro we simply press G twice instead of once to continue the paused document.

Lou Pastura
Annandale, Virginia

WordPerfect, Version 5.0 is more flexible when it comes to printers and fonts, so Version 5.0 users can create a macro that does not just assume you want to return to font #1:

```
<Ctrl-F10>  Begin macro definition
<Alt-P>     Call it Alt-P
<Ctrl-F8>4  Set Base Font
<Down>1     Select the next font
<Ctrl-F8>4  Set Base Font
<Up>1       Re-select original font
<Ctrl-F10>  End macro definition
```

This macro will work as long as the current font isn't the last one in the font list. You can use it on any printer that has more than one font and that pauses whenever there's a font change.—*Neil J. Rubenking*

REDEFINING FUNCTION-KEY COMMANDS

Microsoft Word's function-key commands are generally an asset, but at least one is a menace. I frequently wind up with unwanted printouts by hitting Ctrl-F8 (print) when I meant to hit Shift-F8 simply to highlight a sentence.

Fortunately, *Word* lets you redefine its function keys with macros. Here's a definition for the troublesome Ctrl-F8 that lets you keep the print command on a function key but guards against your typing it accidentally:

```
«ASK CONFIRM=?OK to Print? (Y/N)»«IF
CONFIRM="Y"»
<ctrl esc>pp«ELSE»«QUIT»«ENDIF»
```

With this definition, *Word* will make sure that you know what you are doing before it sends the document to the printer.

Michael Carmen Matti
Carrboro, North Carolina

Two other candidates for this trick are Shift-F10, for marking the whole document, and Alt-F6, for starting the spell check. In both cases, the cursor highlight position is immediately lost, and in a long document it can be quite a hunt to find your place again.—*M. David Stone*

PRODUCTIVITY TIP

When creating a *dBASE III* index to store on a floppy disk, it's faster to create the index on your hard disk drive and use DOS to COPY it than to create the index directly on the floppy disk. This is also true in *Clipper* and *FoxBASE*.

The reason is that *dBASE* reads and writes in 512-byte sectors, while the DOS COPY command reads and writes the complete file (or as much as RAM can hold) all at once.

The same applies to *dBASE*'s COPY FILE, a snail compared to DOS COPY.

INVISIBLE PLACE MARKERS

All the suggestions I've seen for generating place markers in *WordPerfect* documents share the drawback that the markers appear on the screen. Any such marker can change the line and page breaks, and it must also be removed before printing. The following sequence creates a place marker that does not have these undesirable side effects:

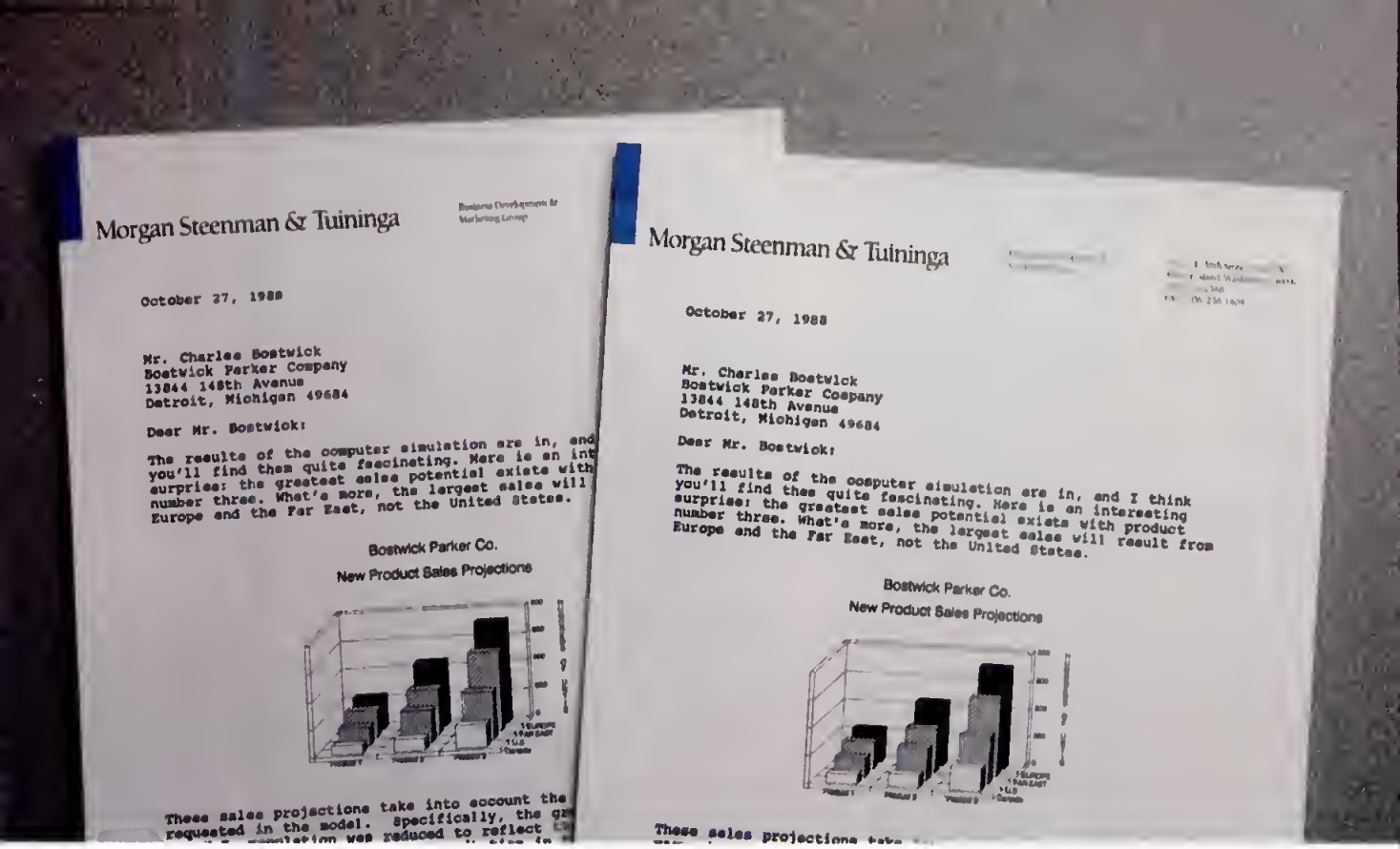
```
F6   (Bold)
->   (Cursor right)
```

This creates a pair of Bold-Unbold codes with nothing in between.

To find the place marker, type

```
F2   (Search)
F6   (Bold)
F6   (Unbold)
F2   (Search)
```

Such a search finds only the isolated Bold-



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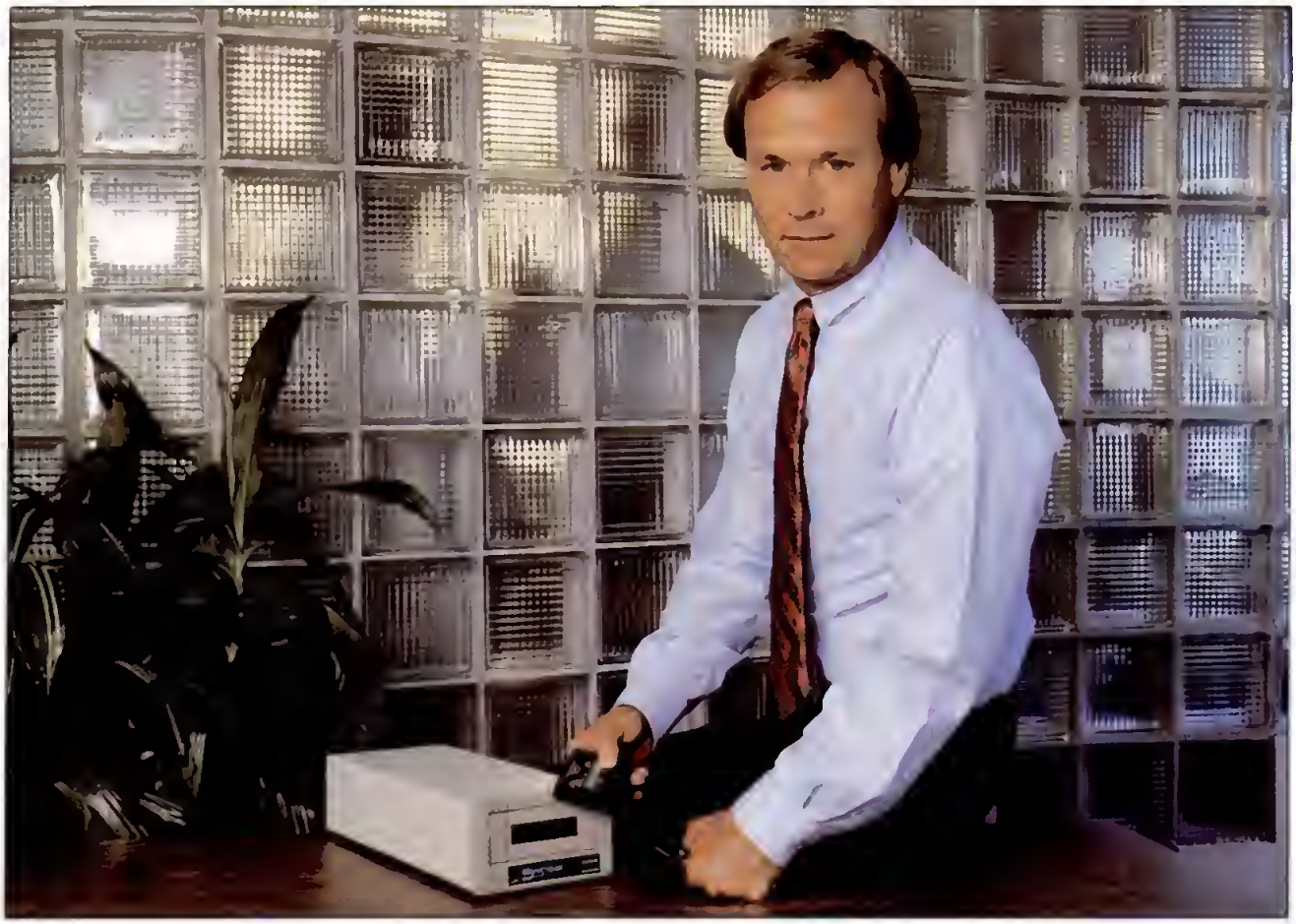

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Unbold pairs, ignoring any such pairs you're using to affect text. Further, this marker technique works equally well with Shift-F2 (backwards search) and Alt-F2 (replace). If a second set of place markers is desired, the F8 (underline) key works identically.

Thomas Cloud
Santa Monica, California

The suggestions to which Cloud refers involve various methods of setting place markers in a document. One especially handy use for such markers is in a macro that retrieves a file and brings you immediately to the place where you were editing when you quit. Such a macro, embodying Cloud's suggestion, might be:

```
<Ctrl-F10>    Begin macro definition
MARKERS       Marker-Save is its name
<F6><Right>   Insert [Bold][bold]
              marker
<F7>Y<CR>YN   Save doc. and clear screen
<Ctrl-F10>    End macro definition
```

After you save a document with the MARKERS macro it will have a [Bold] [bold] marker at the spot you were editing when you quit. MARKERS works in Version 4.2 or 5.0 and assumes that the document you're editing already has a name; it will fail with an unnamed new document.

Another simple macro, MARKERG, takes you to the in-file marker and deletes it on arrival:

```
<Ctrl-F10>    Begin macro definition
MARKERG       Marker-Go is its name
<Alt-F2>N     Search/repl. w/o
              confirm
<F6><F6><F2>  Find [BOLD][bold]
               marker
<F2>          Replace with nothing
<Ctrl-F10>    End macro definition
```

Actually, this macro cleans up all markers in the file and leaves the cursor at the *last* one. Again, the macro works for either Version 4.2 or 5.0.—*Neil J. Rubenking*

TESTING FOR POWER FAILURES

Power interruptions, to which our site is prone, can be devastating to *dBASE* files and indexes.

To test for successful completion of long processing runs—especially those that run unattended or overnight, I've developed a simple technique. I put the various commands needed to process the database in a program, and, before processing begins, I establish a .MEM file thus:

```
PUBLIC isdone
isdone=.F.
SAVE ALL LIKE isdone TO ok
```

This is followed by the various program commands to process the file. After the processing commands, I add

```
SET SAFE OFF
isdone=.T.
SAVE ALL LIKE isdone TO ok
QUIT
```

Next morning, after entering *dBASE*, I can issue the commands

```
RESTORE FROM ok
? isdone
```

If `isdone` is "True," I know the power didn't fail during the night.

Herb Billings III
Dallas, Texas

In another part of his letter, Mr. Billings describes using the same technique in a program in which corrupted indexes were causing problems. In that situation, the `isdone` memory variable is tested at the beginning of the program. If it shows that the process was terminated prematurely (for whatever reason), the indexes are automatically rebuilt as a safety precaution.

Extending the technique, you could save the memory variable as a character string that holds DTOC(DATE()) and/or TIME(). In this way you could also track when the last successful update was completed or how long it took.—*Brad Stark*

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edited by
Tony Rizzo

Languages

REPLACING A STRING

Searching and replacing text in a string is easy if the original text is the same length as the replacement. But I needed a more intelligent routine that could substitute multiple occurrences of one string within another, regardless of their lengths. The program SUBST.BAS, shown in Figure 1, accepts a source string, the strings to search for and to replace with, as well as a starting position in the source string.

Jim Weisenbach
Seattle, Washington

PC MAGAZINE Because this routine relies on INSTR to do the actual searching, it is case sensitive. However, modifying it to honor capitalization is easy by using the UCASE$ function in QuickBASIC 4.0 and Turbo Basic. Simply change the line x = INSTR(start, text$, old$) to x = INSTR(start, UCASE$(text$), UCASE$(old$)). Also, you should specify 1 as a starting offset if the entire source string is to be considered.—*Ethan Winer*

BUILD WINDOWS IN C

To support the development of programs that incorporate pop-up and pull-down windows in their user interfaces, I have developed a small suite of routines in Turbo C that allow me to save the portion of video memory that will be overwritten by a window and later close the window by restoring the video buffer.

The functions PushWindow() and PopWindow() work just like push and pop instructions for a stack: you call PushWindow() as many times as needed to open a series of windows, then close them in reverse order with successive calls to PopWindow(). PushWindow() is passed four parameters that define the window's location and size. PopWindow() requires no parameters, since it simply restores the screen region whose coordinates are next in line on the stack. The function InitWindow() is called once at the beginning to initialize internal variables.

In their present state, these functions furnish bare-bones windowing support. Useful additions might include support for text screens with more than 80 columns, stack overflow and underflow protection, and logic to suppress snow on CGA video adapters.

Jeffrey D. Miller
Green Bay, Wisconsin

- **REPLACING A STRING: A simple and intelligent search-and-replace technique for strings in BASIC.**
- **BUILD WINDOWS IN C: Pop-up and pull-down windowing support for your C programs.**
- **TEXT DISPLAY IN GRAPHICS MODE: A clever way to display text at any location on a graphics screen in BASIC.**
- **COMPUTING TIME VALUES: A program that calculates time values in BASIC.**

SUBST.BAS COMPLETE LISTING

```
SUB SUBST (old$, new$, text$, start)
    gap = LEN(old$)
    n = LEN(text$)
    IF start <= n THEN
       x = INSTR(start, text$, old$)
       DO WHILE x > 0
          text$ = LEFT$(text$, x - 1) + new$ +_
            RIGHT$(text$, n + 1 -(x + gap))
          n = LEN(text$)
          x = INSTR(x, text$, old$)
       LOOP
    END IF
END SUB
```

AVAILABLE ON PC MAGNET

Figure 1: A subprogram to replace all occurrences of one string with another.

PC MAGAZINE I took you up on your suggestion and reworked the code slightly, adding support for varying column widths and removing a reference to Turbo C's MK_FP macro to make the code compatible with both Turbo C and Microsoft C. I also added a few lines to include overflow and underflow protection for the global array WinData, which serves as a LIFO stack for window parameters. I assume that when you talk about stack checking, you're referring to WinData and not to the CPU stack. Conventional stack checking is handled by the compiler.

In my modified version of the code shown in Figure 2, PushWindow() and PopWindow() are integer functions whose return values indicate whether or not the call succeeded. Both will return 0 if there is no error. PushWindow() will return 1 if its execution would cause a stack overflow condition, and PopWindow() will return 1 for stack underflow. Their use in the function main() in the listing shows how these two functions should normally be used. In this case, the program simply terminates with an error message if the size of the WinData array (defined by the parameter MAX_WINDOWS) is about to be exceeded.

In addition, PushWindow() returns an error code of 2 if the capacity of the storage array WinBuffer would be exceeded. The default buffer size of 10,000 words is enough to store the characters and attributes for five windows, each a full 25 lines by 80 columns in size. The number of screen regions that can be stored increases as window size decreases. The default values of 10 for MAX_WINDOWS and 10,000 for BUFFER_SIZE limit total storage capacity to 10 windows or 20,000 bytes, whichever comes first. You can increase available storage space by adjusting these parameters to be proportionately higher.

PushWindow() is called with four parameters: the row and column address of the window's top left corner, the window's height in rows, and its width in columns, in

that order. All parameters are zero-based, so the address of the character cell in the upper-left-hand corner of the screen is 0, 0. PushWindow() and PopWindow() assume that the current video page is page zero.

The parameters that define a window are stored in a structure. An array of these structures, WinData, holds information on up to 10 windows. When PushWindow() is called to save the contents of a new region, the window parameters passed to it are saved in the array element addressed by WinNum, a variable that keeps track of how many windows have been pushed onto the stack and doubles as an index into the array. PopWindow() retrieves the parameters before restoring a region to its previous state, then decrements WinNum to indicate that there is one less window on the stack.

A record of the current position of the write pointer within the save buffer is maintained in BufferPtr. When character/attribute pairs are transferred to the save buffer by PushWindow(), BufferPtr serves as an index that is incremented after each word is written. PopWindow() reverses the operation, starting at the current buffer location and reading backwards to restore the window. PushWindow() starts at a window's upper-left-hand corner and works toward the lower right; PopWindow() proceeds in exactly the opposite direction, from lower right to upper left.

Adding snow suppression for CGA video adapters is more difficult than it might at first seem. The overhead involved in making a function call from a high-level language (and yes, in this context, C is a high-level language) is too great for a program to respond to the signal that a horizontal retrace has begun before the retrace period ends. The solution is to resort to assembly language—a method that presents some powerful alternatives but is beyond the scope of this discussion.

These routines might best be used as part of a larger and more comprehensive library of windowing functions that draw borders, fill windows with text, and more. *—Jeff Prosise*

TEXT DISPLAY IN GRAPHICS MODE

Even though text can be printed in graphics mode with the BASIC PRINT command, it

WINDOWS.C — **COMPLETE LISTING**

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```
#define MAX_WINDOWS 10
#define BUFFER_SIZE 10000

typedef unsigned char BYTE;

struct WindowData{
    BYTE Row;
    BYTE Col;
    BYTE Height;
    BYTE Width;
} WinData[MAX_WINDOWS];

int WinNum = -1;                    /* Index into WinData array */
unsigned ScreenCols;                /* Number of columns displayed */
unsigned far *VideoSeg;             /* Pointer to video segment */
unsigned BufferPtr = 0;             /* Buffer index */
unsigned WinBuffer[BUFFER_SIZE];    /* Buffer for saved screen data */

main()  /* Illustrates the use of window functions */
{
    InitWindow();

    if (PushWindow(0, 0, 8, 40)) {
        printf("Overflow error\n");
        exit(1);
    }

    /*--------------------------------------*/
    /* Insert code to fill first window here */
    /*--------------------------------------*/

    if (PushWindow(10, 15, 10, 50)) {
        printf("Overflow error\n");
        exit(1);
    }

    /*--------------------------------------*/
    /* Insert code to fill second window here */
    /*--------------------------------------*/

    if (PopWindow()) {
        printf("Underflow error\n");
        exit(1);
    }

    if (PopWindow()) {
        printf("Underflow error\n");
        exit(1);
    }
}

InitWindow(void)
{
    if (*(unsigned far *) 0x00400063 == 0x3B4)
        VideoSeg = (unsigned far *) 0xB0000000;
    else
        VideoSeg = (unsigned far *) 0xB8000000;
    ScreenCols = *(unsigned far *) 0x0040004A;
}

PushWindow(BYTE Row, BYTE Col, BYTE Height, BYTE Width)
{
    unsigned Offset;
    BYTE i, j;

    if (WinNum == 9)        /* Check for overflow */
        return(1);
    if ((BufferPtr + Height * Width) > BUFFER_SIZE)
        return(2);

    WinData[++WinNum].Row = Row;    /* Save window parameters */
    WinData[WinNum].Col = Col;
    WinData[WinNum].Height = Height;
    WinData[WinNum].Width = Width;

    Offset = (Row * ScreenCols) + Col;
    for (i=0; i<Height; i++)
        for (j=0; j<Width; j++)
            WinBuffer[BufferPtr++] = *(VideoSeg + Offset +
                                       (i*ScreenCols) + j);

    return(0);
}

PopWindow(void)
{
    unsigned Offset;
    int i, j;

    if (WinNum == -1)       /* Check for underflow */
        return(1);

    Offset = (WinData[WinNum].Row * ScreenCols) + WinData[WinNum].Col;
    for (i=WinData[WinNum].Height-1; i>-1; i--)
        for (j=WinData[WinNum].Width-1; j>-1; j--)
            *(VideoSeg + Offset + (i*ScreenCols) + j) =
                WinBuffer[--BufferPtr];

    WinNum--;
    return(0);
}
```

Figure 2: The WINDOWS.C listing shown above contains several routines that support the ability to create pop-up and pull-down windows.

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EDITOR'S CHOICE

PC MAGAZINE

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PC MAGAZINE

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must start at normal character positions. In many cases, it would be useful to position the text at any arbitrary pixel location—for example, when centering a label about an axis tick mark. One way to accomplish this is to use BASIC's LINE statement with the optional Style argument that draws dashed lines. The short example program shown in Figure 3 derives the appropriate style by PEEKing at the character-shape table. This table is stored in ROM at segment &HFFA6, beginning at address &H0E (14 decimal).

William G. Hood
Conway, Arizona

We have published other programs that draw text by PEEKing at the ROM character table, but all of them manipulated individual bits and were thus very slow. Mr. Hood's use of an entire byte as a LINE style is quite clever and allows this routine to run relatively quickly. I modified the original submission slightly to also operate in EGA screen 9,

TEXT.BAT — **COMPLETE LISTING**

```
DEFINT A-Z
CLS
INPUT "Enter screen mode (1/2/9) ", Mode
   SELECT CASE Mode
   CASE 1
      MaxColor = 3
   CASE 2
      MaxColor = 1
   CASE 9
      MaxColor = 15
   CASE ELSE
      END
   END SELECT

SCREEN Mode
DEF SEG = &HFFA6                    'ROM segment for character shape tables

DO
   CLS
   INPUT "Enter something to print "; A$
   IF A$ = "" THEN SCREEN 0: END

   X = 13                           'X/Y location to start printing
   Y = 20
   CO = 1                           'initial color

   FOR I = 1 TO LEN(A$)             'step through the string
      Addr = 8 * ASC(MID$(A$, I)) + 14 'address character shape table
      FOR J = 0 TO 7                'print the character
         LINE (X + 7, Y + J)-(X, Y + J), CO, , PEEK(Addr + J) * 128
      NEXT
      X = X + 10                    'advance right ten pixels
      Y = Y + 3                     'go down three pixels
      CO = CO + 1                   'increment the color by one
      IF CO > MaxColor THEN CO = 1  'wrap if at the maximum for
   NEXT                             'this mode
   WHILE INKEY$ = "": WEND          'give 'em time to see it
LOOP                                'prompt for another message
```

Figure 3: This example shows how to display text at any arbitrary pixel position in the BASIC graphic screen modes. TEXT.BAT achieves the appropriate style by PEEKing at the character-shape table.

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NEWTIME.BAS — **COMPLETE LISTING**

```
DEF FnNewTime$ (t1$, Op$, t2$)

    hour1 = VAL(t1$)              'parse hour values
    hour2 = VAL(t2$)

    min1 = VAL(MID$(t1$, 4))      'parse minute values
    min2 = VAL(MID$(t2$, 4))

    sec1 = VAL(RIGHT$(t1$, 2))    'parse second values
    sec2 = VAL(RIGHT$(t2$, 2))

    IF Op$ = "+" THEN             'add times

       hourval = hour1 + hour2    'add hours
       minval = min1 + min2       'add minutes
       secval = sec1 + sec2       'add seconds

       IF secval > 59 THEN        'check to carry a minute
          secval = secval - 60
          minval = minval + 1
       END IF

       IF minval > 59 THEN        'check to carry an hour
          minval = minval - 60
          hourval = hourval + 1
       END IF

       DO WHILE hourval > 23      'check to see if next day
          hourval = hourval - 24
       LOOP

    ELSEIF Op$ = "-" THEN         'subtract times

       IF sec2 > sec1 THEN        'look to borrow a minute
          sec1 = sec1 + 60
          min1 = min1 - 1
       END IF
       secval = sec1 - sec2       'subtract seconds

       IF min2 > min1 THEN        'look to borrow an hour
          min1 = min1 + 60
          hour1 = hour1 - 1
       END IF
       minval = min1 - min2

       IF hour2 > hour1 THEN      'look to borrow a day
          DO UNTIL hour1 > hour2
             hour1 = hour1 + 24
          LOOP
       END IF
       hourval = hour1 - hour2

    'wasn't "+" or "-"
    ELSE
       FnNewTime$ = "Illegal Operation"
       EXIT DEF
    END IF

    'set the final result
    hour$ = MID$(STR$(hourval), 2)
    minute$ = MID$(STR$(minval), 2)
    sec$ = MID$(STR$(secval), 2)

    'pad any empty slots
    WHILE LEN(hour$) < 2
       hour$ = "0" + hour$
    WEND
       WHILE LEN(minute$) < 2
          minute$ = "0" + minute$
       WEND

       WHILE LEN(sec$) < 2
          sec$ = "0" + sec$
       WEND

       FnNewTime$ = hour$ + ":" + minute$ + ":" + sec$

END DEF

INPUT "First time : ", t1$
INPUT "Second time: ", t2$
INPUT "Operator (+/-): ", Op$

IF LEN(t1$) <> 8 OR LEN(t2$) <> 8 OR (Op$ <> "+" AND Op$ <> "-") THEN
   PRINT "Invalid format!"
   END
END IF

PRINT FnNewTime$(t1$, Op$, t2$)
```

Figure 4: The listing NEWTIME.BAS demonstrates how to calculate time values.

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CIRCLE 193 ON READER SERVICE CARD

Languages

and it would be equally simple to accommodate any of the other BASIC graphics modes.—*Ethan Winer*

COMPUTING TIME VALUES

As part of a program I developed to compute tide charts, I needed to be able to calculate time values. The function shown in the listing NEWTIME.BAS (Figure 4) will add or subtract a starting time and a relative offset. It can start with 12:30:55 and add 01:03:03, which results in the new time 13:33:58. NewTime takes three parameters—a base time in hh:mm:ss format, an operator that must be "+" or "−", and the time to be added or subtracted.

Dennis W. Friedel
Millsboro, Delaware

In the original program, Mr. Friedel had included extensive error-trapping to catch illegal time values. Because of the limited space in the magazine, I had to remove many of those tests. However, it would probably make more sense to check for valid times *before* calling this function.—*Ethan Winer*

NEWTIME.BAS adds or subtracts a starting time and a relative offset. Check for valid times before calling it.

SPEAK YOUR LANGUAGE

Share your knowledge of BASIC, C, Pascal, FORTRAN, and COBOL with Languages readers. We'll pay you $50 or more for any tips we print, *plus an extra $25 if you submit your letter on a disk.* If you do, please include a printed copy. Mail contributions to Languages, *PC Magazine*, One Park Avenue, New York, NY 10016 or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Utilities column). ■

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CIRCLE 263 ON READER SERVICE CARD

UDS can stand the heat in the V.32 kitchen

The Canadian Standards Association literally put our modem to the torch. The UDS V.32 in this photo suffered considerable cosmetic distress, but as bad as the unretouched damage looks, the modem still handles data normally. For more details on V.32s that can take anything you throw at them, contact:

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CIRCLE 367 ON READER SERVICE CARD

by
Frank J. Derfler, Jr.

Connectivity Clinic

- **LAN CONNECTIONS:** Alternatives for connecting one LAN to another.
- **OS/2 LAN SOFTWARE:** Bringing quiet to chaos—sorting out LAN operating systems.
- **CALL FRAMEWORK II FROM A BATCH FILE:** Custom batch files help you tailor a program's specifications.
- **TOKEN-RING OPTIONS:** There are many options in Token-Ring hubs.

LAN CONNECTIONS

We heve e Novell/Ethernet LAN installetion in Chile that needs to be accessed by another site about 500 miles away. The standerd Novell solution for connecting remote sites requires that a PC with a modem be set up as e "remote bridge" on the LAN. This setup was tested with 1,200-bit-per-second modems and performance was unacceptable—testing was aborted efter the application took an hour to boot. Because file transfer appeared to be the problem, we tried dialing in using *Carbon Copy Plus* et both ends, and performance was eccept-able.

The sites in Chile each have a PAD (Packet Assembler Disassembler) connected by a 9,600-bps X.25 link, which are used to connect e VAX to terminals at the LAN site. It's possible to install an X.25 geteway for the Novell LAN, but there is concern that performance will still be poor when transmitting entire files over the wire, even at 9,600 bps.

Is there anything similar to *Carbon Copy Plus* that works over X.25? Is X.25 feasible or are modems really the best way to go? Is there a solution we are missing?

Scott Feuless
(via CompuServe)

PC MAGAZINE For this situation X.25 buys you only improved data transmission. You can get the same performance by using modems with the MNP error-correction protocols. X.25 certainly won't give you increased throughput.

Performance at 9,600 bps will continue to be slow if you use the Novell remote-client-connection option. This means of connection is nice because it makes a remote PC a true part of the network. Features such as redirection and virtual drives are fully supported. Unfortunately, these features bring with them a great deal of overhead—such as heavily formatted low-level information—that must be transmitted across the channel.

A remote-control program such as *Carbon Copy*, *Remote*^{2}, or *PC Anywhere* ties up a CPU at the LAN location but only screen changes and keystrokes are passed over the communications link.

I suggest you look into using a device like a J&L Products Chatterbox as an asynchronous connection server for the LAN. Place several CPU cards in the Chatterbox, make each card a node on the LAN, hook each card to a modem, and let people run them by remote control. Use either the RS-232C channels provided by the X.25 PAD or regular voice-grade lines using 9,600-bps modems meeting the international V.32 standard. You will be pleased by both the throughput and the life-cycle cost.

OS/2 LAN SOFTWARE

Thenk you for the LAN articles that appeared in the June 14, 1988, issue. They helped cleer up some of my confusion about this complex topic. Since then I have read about several other aspects of future LAN products, and I hope you can help me understand them.

IBM talks about its *OS/2 LAN Server* and Microsoft talks about its *OS/2 LAN Maneger*, which 3Com supports. Will DOS workstations be able to work with OS/2-based file servers or will the workstations also have to run OS/2? I've also heard e great deal about "distributed applications." Will it be necessary to add enother leyer to these LAN operating systems for this?

It seems obvious that OS/2 should provide a better networking base than DOS for LANs, but I am in the dark as to how these things will fit together.

William Newton
Madrid, Spain

PC MAGAZINE Here are some of the points you need to understand in order to make sense of OS/2 LAN software. Microsoft and 3Com together developed a product called *OS/2 LAN Manager*. *OS/2 LAN Manager* itself is a "core" product that LAN vendors purchase from Microsoft. Typically the vender adds additional pieces (or features) to this core product, then relabels and markets it to the end user. There are currently more than 30 different companies doing so.

3Com and IBM are two of the companies remarketing Microsoft's *OS/2 LAN Manager*. 3Com calls its version *3+Open LAN Manager* and IBM calls its version *OS/2 LAN Server*. (It doesn't help that IBM has a completely different and unrelated product called *LAN Manager*.) Features that vendors add to the core *OS/2 LAN Manager* product include drivers for various networking cards and utilities such as e-mail, as well as their own end-user screen interfaces.

The question of distributed applications is complex, but to answer the question specifically, you should not have to add anything to an *OS/2 LAN Manager*–based network to use distributed applications. Distributed applications such as electronic mail, database programs, and network gateways use features that are already built into the *LAN Manager* product.

However, there are at least three communications methods that distributed applications can use to communicate across a LAN. Not all versions of *OS/2 LAN Man-*

ager support all of the communications options.

NetBIOS will remain the most popular network communications service for a long time. Software developers know how to write applications using NetBIOS calls, it is widely available, and it works. Each version of *OS/2 LAN Manager* sold to the end user will support NetBIOS, which means it will remain the platform for distributed applications in the near term and for a long time to come.

Microsoft introduced a communications service called Named Pipes in *OS/2 LAN Manager*, but it isn't in the present release of IBM's *OS/2 LAN Server*. Programmers will find Named Pipes much easier to use than NetBIOS, but it will take some time for most programmers to abandon the libraries of NetBIOS routines that they know how to use.

IBM's alternative to Named Pipes is Advanced Program-to-Program Communications (APPC). APPC takes up a huge amount of RAM and isn't practical for PC-to-PC applications, but some PC-to-mainframe programs use it. IBM makes the picture even more confusing because it has introduced a program interface for *OS/2 LAN Server* in the Extended Edition of the Presentation Manager that is not yet supported in Microsoft's generic products.

NetBIOS will be the most popular network communications service for a long time. Software developers know how to write applications using it, and it's readily available.

Fortunately, Microsoft has announced that it will support this interface "soon."

It is very crucial for the many DOS-based workstations in the business world to work with *LAN Manager*–based servers. Most companies remarketing *LAN Manager* will therefore provide software for DOS workstations that will allow them to use NetBIOS and Named Pipes.

CALL FRAMEWORK II FROM A BATCH FILE

I manage a Novell LAN with 35 stations. One of the principal applications on the LAN is *Framework II*. Since *Framework*'s LAN version is not yet available, we had difficulty with the setup file. *Framework* uses a file called FWSETUP to establish the video and printer drivers and other default settings. At first we used a single setup file, but as different workstation configurations appeared on the LAN, we had problems.

Our solution was to call *Framework* from a batch file that copied a unique FWSETUP file and the *Framework* overlay file to the default directory. From this point execution proceeds normally. Since *Framework* is not licensed for a LAN, you must have a copy for each station running

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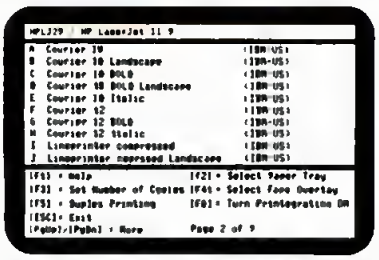

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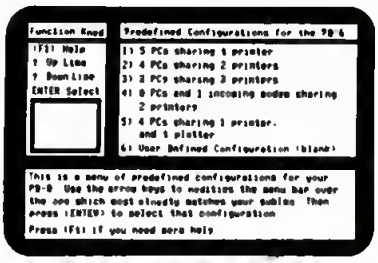

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Automatic form feed	Y	Y		Y
Forms overlay printing	Y			
Text enhancement	Y			
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Resource utilization reports	Y			

PC MAGAZINE EDITOR'S CHOICE

LaserJet Series II Printer is a trademark of Hewlett-Packard Co

CIRCLE 522 ON READER SERVICE CARD

the program. We have 15 copies and use a batch counter to stop *Framework* from running a 16th time.

Jim Webster
Vienna, Virginia

PC MAGAZINE This tip shows how you can use a batch file to tailor a program's specifications. It requires a customized batch file for each workstation, but you only need to create or change the file if you reconfigure the video card, printer, or other features of the workstation.

TOKEN-RING OPTIONS

The April 26, 1988, issue of *PC Magazine* had a review of multistation access units (MAUs) in which you thought very highly of the Proteon ProNET-4 MAU ("Making Connections: Two Token-Ring Alternatives"). We are planning a Token-Ring installation and would like to know if you still hold your high opinion of the Proteon MAU.

William Phlan
New York, New York

PC MAGAZINE The Proteon MAU still offers the greatest number of operational features of any of the MAUs on the market. Because it uses AC power with a battery backup, relays do not need to be realigned each time it is moved, and the software reporting system provides an excellent way to monitor and control traffic and stations on the ring. The Proteon MAU also comes with a relatively high price.

The Proteon MAU has the greatest number of operational features.

If all the features of the Proteon MAU are not needed, you should consider Thomas-Conrad Corp.'s $985 TC4050 MAU, which includes a number of useful features, like maintenance and troubleshooting controls, and operational indicators. It costs less on a per-port basis than "dumb" MAUs from other companies.

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CIRCLE 504 ON READER SERVICE CARD

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*Starch Study, July 1986

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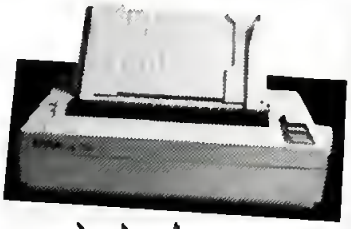

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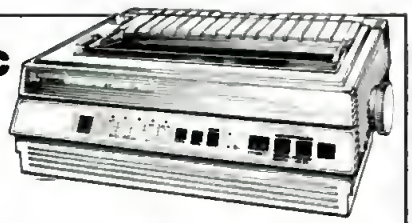

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Speed (Mhz)	8/4.77	10/4.77	12/4.77	12.5/8	16/8	20/8	24/8
BIOS	ERSO	ERSO	ERSO	AMI	AMI	AMI	AMI
Wait States	1	0/1	0/1	0/1	0/1	0/1	1
Standard Memory Config.	640K	640K	640K	1MB	1MB	1MB	1MB
On Board Memory Expansion				4MB	8MB	8MB	8MB
Shadow RAM BIOS					384K	384K	384K
Coprocessor Support	8087	8087	8087	80287	80287	80387	80387
Expanion Slots	8-8 bit	8-8 bit	8-8 bit	2-8,6-16	2-8,6-16	2-8,5-16	2-8,5-16
Dual Hard Floppy Controller	w/H D.	w/H D.	w/H D.	Yes	Yes	Yes	Yes
Device Bays(E-external,I-Int.)	4-E	2-E,2-I	2-E,2-I	3-E,2-I	3-E,2-I	3-E,2-I	3-E,2-I
Serial Ports	1	1	1	optional	optional	optional	optional
Parallel Ports	2	2	2	1	1	1	1
Game Ports	2	2	2	1	1	1	1
Bus Mouse Port	1	1	1	1	1	1	1
Power Supply Size	150W	150W	150W	200W	200W	200W	200W
Key Tronics USA Keyboard	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EZ-DOS 4.0 w/GEM,TopDOS	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery Backup Clock	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Norton SI Rating 4.0Version	1.8	2.1	4.9	14	18.3	22.5	26
Landmark Speed	3.1	4.1	5	10.5	21	24	28

	MODEL/DESCRIPTION	BASE	MONO 720X350	CGA 640X200	EGA 640X350	VGA 640X480	XVGA 800X600
PC/XT 640K 8 Mhz	1 / (1) 360K Floppy Drive	$539	$619	$739	$1,039	$1,079	$1,244
	2 / (2) 360K Floppy Drives	$609	$689	$809	$1,109	$1,149	$1,314
	20 / 22MB,60mils,MFM,KC-20	$839	$919	$1,039	$1,339	$1,379	$1,544
	30 / 33MB,60mils,RLL,KC-30	$879	$959	$1,079	$1,379	$1,419	$1,584
88-10 640K 10 Mhz	1 / (1) 360K Floppy Drive	$589	$669	$789	$1,089	$1,129	$1,294
	2 / (2) 360K Floppy Drives	$659	$739	$859	$1,159	$1,199	$1,364
	20 / 22MB,60mils,MFM,KC-20	$889	$969	$1,089	$1,389	$1,429	$1,594
	30 / 33MB,60mils,RLL,KC-30	$929	$1,009	$1,129	$1,429	$1,469	$1,634
88-12 640K 12 Mhz	1 / (1) 360K Floppy Drive	$639	$719	$839	$1,139	$1,179	$1,344
	2 / (2) 360K Floppy Drives	$709	$789	$909	$1,209	$1,249	$1,414
	20 / 22MB,60mils,MFM,KC-20	$939	$1,019	$1,139	$1,439	$1,479	$1,644
	30 / 33MB,60mils,RLL,KC-30	$979	$1,059	$1,179	$1,479	$1,519	$1,684
286-12 1024K 12.5Mhz 0-Wait	1 / (1) 1.2MB Floppy Drive	$939	$1,019	$1,139	$1,439	$1,479	$1,644
	20 / 22MB,60mils,MFM,2-1,KC-20	$1,179	$1,259	$1,379	$1,679	$1,719	$1,884
	20 / 22MB,38mils,MFM,2-1,ST125	$1,219	$1,299	$1,419	$1,719	$1,759	$1,924
	30 / 33MB,38mils,MFM,2-1,ST138	$1,289	$1,369	$1,489	$1,789	$1,829	$1,994
	40 / 42MB,60mils,MFM,2-1,MS3650	$1,299	$1,379	$1,499	$1,799	$1,839	$2,004
	40 / 42MB,38mils,RLL,1-1,MS8045	$1,379	$1,459	$1,579	$1,879	$1,919	$2,084
	40 / 42MB,26mils,IDE,1-1,MS8051	$1,379	$1,459	$1,579	$1,879	$1,919	$2,084
	65 / 65MB,40mils,RLL,1-1,MS3650	$1,379	$1,459	$1,579	$1,879	$1,919	$2,084
	85 / 85MB,28mils,SCSI,1-1,ST296N	$1,579	$1,659	$1,779	$2,079	$2,119	$2,284
	120 / 120MB,28mils,RLL,1-1,ST4096	$1,809	$1,889	$2,009	$2,309	$2,349	$2,514
286-16 1024K 16 Mhz 0-Wait	1 / (1) 1.2MB Floppy Drive	$1,259	$1,339	$1,459	$1,759	$1,799	$1,964
	20 / 22MB,60mils,MFM,2-1,KC-20	$1,499	$1,579	$1,699	$1,999	$2,039	$2,204
	20 / 22MB,38mils,MFM,2-1,ST125	$1,549	$1,629	$1,749	$2,049	$2,089	$2,254
	30 / 33MB,38mils,MFM,2-1,ST138	$1,609	$1,689	$1,809	$2,109	$2,149	$2,314
	40 / 42MB,60mils,MFM,2-1,MS3650	$1,629	$1,709	$1,829	$2,129	$2,169	$2,334
	40 / 42MB,38mils,RLL,1-1,MS8045	$1,699	$1,779	$1,899	$2,199	$2,239	$2,404
	40 / 42MB,26mils,IDE,1-1,MS8051	$1,699	$1,779	$1,899	$2,199	$2,239	$2,404
	65 / 65MB,40mils,RLL,1-1,MS3650	$1,699	$1,779	$1,899	$2,199	$2,239	$2,404
	85 / 85MB,28mils,SCSI,1-1,ST296N	$1,899	$1,979	$2,099	$2,399	$2,439	$2,604
	120 / 120MB,28mils,RLL,1-1,ST4096	$2,029	$2,109	$2,229	$2,529	$2,569	$2,734
386-20 1024K 20 Mhz 0-Wait	1 / (1) 1.2MB Floppy Drive	$1,779	$1,859	$1,979	$2,279	$2,319	$2,484
	20 / 22MB,38mils,MFM,2-1,ST125	$2,059	$2,139	$2,259	$2,559	$2,599	$2,764
	30 / 33MB,38mils,MFM,2-1,ST138	$2,129	$2,209	$2,329	$2,629	$2,669	$2,834
	40 / 42MB,26mils,IDE,1-1,MS8051	$2,209	$2,289	$2,409	$2,709	$2,749	$2,914
	65 / 65MB,40mils,RLL,1-1,MS3650	$2,209	$2,289	$2,409	$2,709	$2,749	$2,914
	85 / 85MB,28mils,SCSI,1-1,ST296N	$2,409	$2,489	$2,609	$2,909	$2,949	$3,114
	120 / 120MB,28mils,RLL,1-1,ST4096	$2,539	$2,619	$2,739	$3,039	$3,079	$3,244
386-24 2048K 24 Mhz	1 / (1) 1.2MB Floppy Drive	$2,199	$2,279	$2,399	$2,699	$2,739	$2,904
	20 / 22MB,38mils,MFM,2-1,ST125	$2,489	$2,569	$2,689	$2,989	$3,029	$3,194
	30 / 33MB,38mils,MFM,2-1,ST138	$2,549	$2,629	$2,749	$3,049	$3,089	$3,254
	40 / 42MB,38mils,RLL,1-1,MS8045	$2,639	$2,719	$2,839	$3,139	$3,179	$3,344
	65 / 65MB,40mils,RLL,1-1,MS3650	$2,639	$2,719	$2,839	$3,139	$3,179	$3,344
	85 / 85MB,28mils,SCSI,1-1,ST296N	$2,839	$2,919	$3,033	$3,333	$3,373	$3,538
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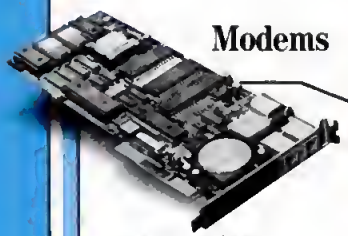

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286 20Mhz 40MB	1737	1917	2077	2143
286 20Mhz 70MB	1937	2117	2277	2343
286 20Mhz 90MB	2137	2317	2477	2543
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386 20Mhz 90MB	2737	2917	3077	3143

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$545

Turbo/10 System	MGA	EGA	VGA
No Hard Drive	$679	$1,029	$1,149
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Business Workhorses. The CompuAdd 286/12 is chosen first by value-minded buyers for its solid performance and low price. In a comparison of five "Hot" 80286 bargains by *PC/Computing* (2/89), CompuAdd's speed came out on top. Little wonder. With a 12MHz processor speed and 0 wait state architecture, the 286/12 is 50% faster than the IBM AT®, with a 13.7 rating on Norton's SI 4.0 test.

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$945

286/12 System	MGA	EGA	VGA
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40MB	$1,499	$1,849	$1,969

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- Two serial ports and a parallel port built-in
- 80287 math coprocessor support
- Enhanced 101-key keyboard
- 20.4 on Norton's SI 4.0 test (22.5 rating with 2MB memory and four-way interleave)

$1595

286/20 System	MGA	EGA	VGA
40MB	$2,155	$2,505	$2,625
80MB	$2,345	$2,695	$2,815

CompuAdd 386/16

- 80386 processor running at 16MHz or 8MHz, 6MHz or 4.77MHz
- 0 wait state (page-mode memory)
- 1MB RAM expandable to 4MB
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- Dual diskette/hard drive controller
- Seven expansion slots
- Two serial ports and a parallel port built-in
- 80287 math coprocessor support
- Choice of enhenced 101-key, AT-style, or 5151 keyboard
- 17.6 on Norton's SI 4.0 test

$1795

386/16 System	MGA	EGA	VGA
40MB	$2,355	$2,705	$2,825
80MB	$2,545	$2,895	$3,015

On-Site Service. You'll get On-Site warranty protection *free* for a full year when you purchase any CompuAdd 286/20 or 386 computer. Just call our toll-free customer support line at the first sign of a problem. If we can't solve it on the phone, a field technician will be at your office the next business day.

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- Dual diskette/hard drive controller
- Seven expension slots
- Two serial ports and e parallel port built-in
- 80387 and Weitek math coprocessor support
- Enhanced 101-key keyboard
- 23.0 on Norton's SI 4.0 test

$2195

386/20 System	MGA	EGA	VGA
40MB	$2,755	$3,105	$3,225
80MB	$2,945	$3,295	$3,415

CompuAdd 386/25

- 80386 processor running at 25MHz or 8MHz
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- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- Duel diskette/hard drive controller
- Seven expension slots
- 80387 and Weitek math coprocessor support
- Enhenced 101-key keyboard
- 28.8 on Norton's SI 4.0 test

$2895

386/25 System	MGA	EGA	VGA
40MB	$3,455	$3,805	$3,925
80MB	$3,645	$3,995	$4,115

"... packed with features—at prices that won't empty your savings account."

PC Magazine (5/30/89)

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Monochrome monographics monitor or upgrade to EGA or VGA color video

Star Micronics NX-1000™ printer with multiple type styles, 120cps draft and 30cps near letter quality.

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Accessories and software including paper, printer cable, ten diskettes and Zen software package with ZenWord™, ZenCalc™, and ZenLink™. Plus CompuAdd MS-DOS® and GW BASIC®. PC-FullBak™ software with optional hard drive.

$879

Hard Drives	Monographics	EGA	VGA
No Hard Drive	$879	$1,229	$1,349
30MB	$1,129	$1,479	$1,599

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Hard Drives	Monographics	EGA	VGA
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40MB	$1,595	$1,945	$2,065

Monitors

Monographics
Flat screen monitor with 12" screen and tilt/swivel.. **$95**

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IBM-compatible color monitor with 13" diagonal screen **$239**

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IBM-compatible 13" EGA monitor **$349**

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Color VGA 13" analog monitor **$415**
Zenith 14" Color VGA monitor 640×480 . . **$649**

Combos

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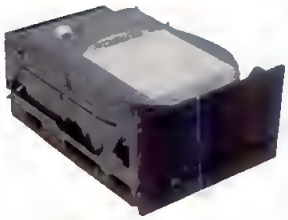

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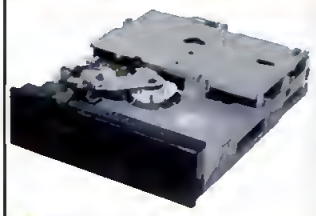

- 360KB 5.25" diskette drive for the XT (black) . . $89
- 360KB 5.25" diskette drive for the AT (gray) . . . $99
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- **Epson LQ-1050** 132 columns 264cps draft, 88cps LQ $739
- **Panasonic 1180** 80 columns, 192cps draft, 38cps NLQ $195
- **Panasonic 1191** 132 columns 240cps draft, 48cps NLQ $259
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- 2400 baud (external) . . . $129
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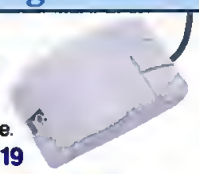

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720KB for 1000/A/SX/TX . . . **$109**

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20MB half-height drive for 1000/A (65ms) **$299**

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RS-232 (M-F) surge suppressor for serial ports . . . **$4.95**

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6' cable (DB25M to C36M) **$9.95**

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6' cable (DB25M to DB25M) **$10.95**

Cards

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XT I/O serial port, parallel port, game port, and clock/calendar **$55**

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Monographics card up to 720×348 resolution **$49**

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CompuAdd EGA-480 IBM/EGA-compatible card with 256KB display memory . . . **$179**

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MEM-576 with 0KB **$35**

EMS XT with 0KB **$99**

EMS AT with 0KB **$119**

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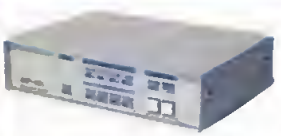

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HS3000 Pictured

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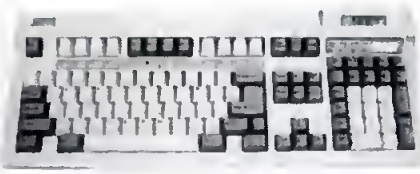

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NEW

QC1478 Pictured

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ST225XT Pictured

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JE3025 Pictured

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JE1200 Pictured

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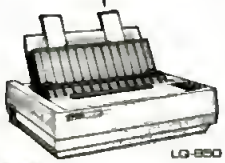

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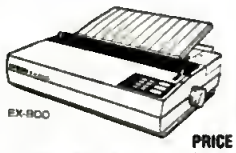

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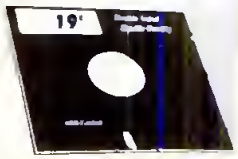

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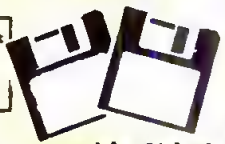

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ST4096	80MB, 28 MSEC, FULL HEIGHT, MFM	599	549	544
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M2535	66MB, 23 MSEC, 1/2 HT., MFM/RLL	479	469	464

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KL330	30MB, 40 MSEC, 3.5", RLL	285	233	CALL
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HC-30	30MB, 40 MSEC HARD CARD (TANDY TOO)	309		
8450	40MB, 45MSEC, 3.5" W/5.25 KIT, RLL	297	247	242
3650	40MB, 61 MSEC, 1/2 HEIGHT, MFM	342	302	297
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EXT-12	1200/300 BAUD EXTERNAL	69
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EXT-24	2400/1200/300 EXTERNAL	118

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			1003-VSR2	AT RLL 2:1 HD/FD	126
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- DUAL 1:1 INTERLEAVE HARD /FLOPPY CONTROLLER
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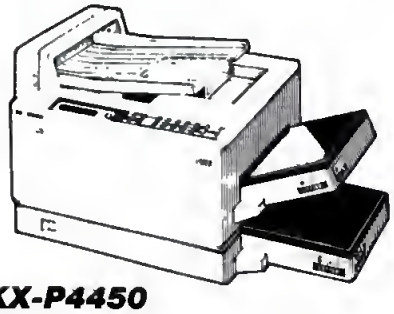

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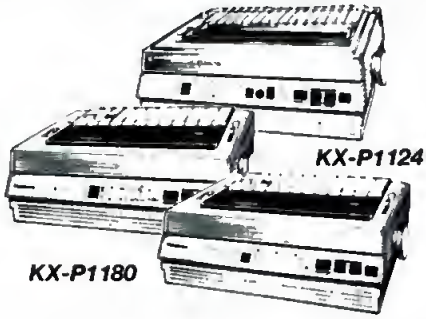

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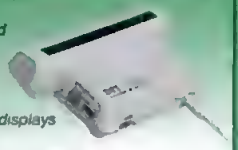

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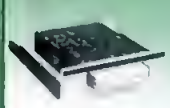

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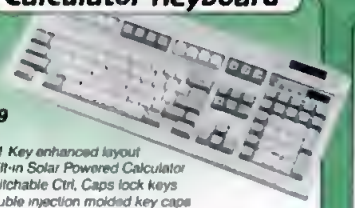

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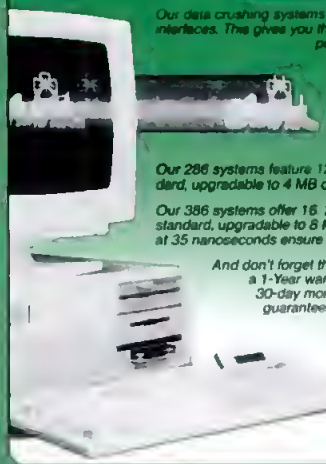

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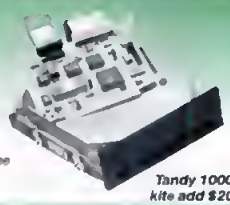

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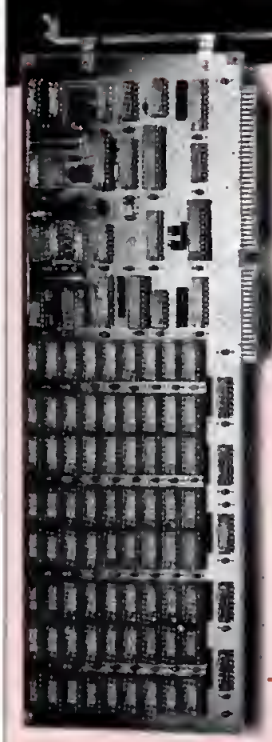

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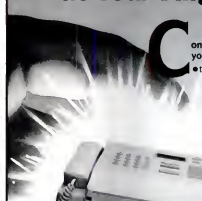

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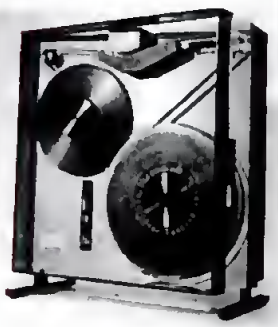

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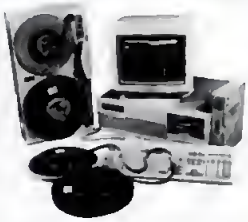

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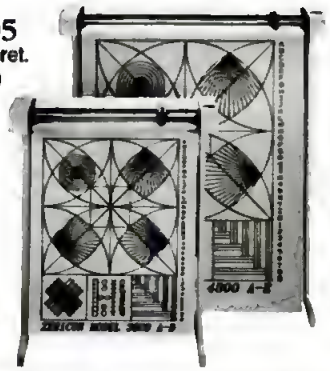

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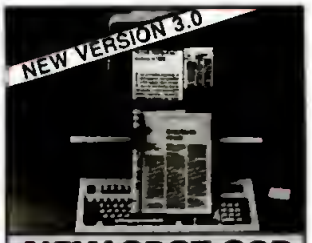

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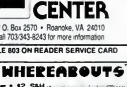

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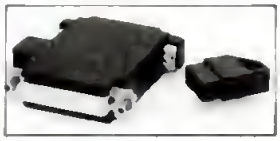

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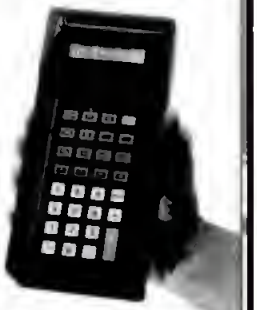

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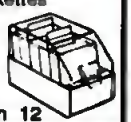

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FTC rules say:

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3. The Seller's notice must contain a stamped self-addressed card or envelope with which you can indicate your preference. If you don't respond to this notice, the Seller may assume you agree to the delay, but must either ship or cancel your order within 30 days after the original shipping date promised or required. A prompt refund must be made when an order is cancelled.

4. Even if you've consented to an indefinite delay, you retain the right to cancel the order at any time before the item has been shipped.

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TIPS WHEN ORDERING

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State precisely what merchandise you want, specifying details such as model, make, size, component parts, etc.;

Confirm the price and expected delivery date as stated in the ad;

Indicate whether you will accept a substitute product if the item you ordered is unavailable, and, if not, that your payment should be returned;

Don't send cash, you will have no record of payment if a problem arises, and;

Keep a copy of your order and all other correspondence with the Seller. Your records should include the company's name, address and phone number; a description of the item ordered; your cancelled check or a copy of the money order; record of the date you mailed the order, or the time and date of your conversation, and the name of the person you talk with, and any sales slips and shopping receipts.

Ask about servicing and refund/return policies and with whom you should correspond if there is a problem.

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1. If you have not received your order as promised or if the item is defective, immediately notify the Seller in writing referring to your order by description, price, date, as well as by account number and order number, if available. Make sure you keep a copy of the letter.

2. If you complain by telephone, send a follow-up letter to confirm what was said.

3. If you think the merchandise is defective, reread your product instructions and your warranty carefully to be sure you don't expect features or performance the product isn't designed to give. Then contact the Seller for instructions. Don't return it to the Seller until you have been instructed to do so.

4. When returning merchandise make sure you keep the shipper's receipt or packing slip, your right to be reimbursed for postal cost is determined by store policy.

5. If you have completely discussed your problem with the Seller and are still not satisfied, write to the consumer complaint agency in the Seller's state. If you paid for the merchandise by credit card, you may have rights to withhold payment under a Federal law called the Fair Credit Billing Act.

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p. ☐ Linked to mini
q. ☐ Networked together

6. Does your company own
r. ☐ Mainframe(s) s. ☐ Mini(s)

7. Do you plan to buy any PC products?
t. ☐ Now
u. ☐ In 4 to 6 months
v. ☐ In 6 to 12 months
w. ☐ No definite plans

8. Number of employees in your entire company?
x. ☐ 25 or less 1. ☐ 500-999
y. ☐ 26-99 2. ☐ 1000 or more
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p. ☐ Linked to mini
q. ☐ Networked together

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r. ☐ Mainframe(s) s. ☐ Mini(s)

7. Do you plan to buy any PC products?
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u. ☐ In 4 to 6 months
v. ☐ In 6 to 12 months
w. ☐ No definite plans

8. Number of employees in your entire company?
x. ☐ 25 or less 1. ☐ 500-999
y. ☐ 26-99 2. ☐ 1000 or more
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COMING UP

■ 80386SX COMPUTERS

Intel's decision to cut 386SX chip prices has fueled the debate between the 286 and 386 camps. The first 386SX PCs to hit the market—of which we review 14—have cut a wide swath in both price and design. Executive editor Bill Howard puts together his ideal SX computer, taking cues from some savvy design choices found among the machines in this roundup.

This issue also marks the debut of the PC Labs Benchmark Series, Version 5.0; we explain its new features.

■ BACKUP SOFTWARE

Whether you lead a charmed life or one in which anything that can go wrong does, backup software is for you. It lets you preserve crucial files, provide temporary storage, and transfer your data between two computers—in short, relieve unnecessary worry. Contributing editor Edward Mendelson delves into the history and technology of backup software and rates 15 backup programs on their speed and safety.

■ BASIC LANGUAGES

Not just for beginners, BASIC is known and used by more people than is any other PC programming language. Easier to learn and ultimately more powerful than C or Pascal, BASIC also offers more capability and features than you may think. PC Labs takes an in-depth look at ten products, and offers a hard look at how BASIC is being used today—and where it's headed.

■ VGA MONOCHROME MONITORS

For those who must have VGA capability or bust—but can't afford to bust their piggy banks—a VGA monochrome monitor is the way to go. You are not sacrificing quality; images can be sharper than those formed by color VGA displays. Our look at 27 often closely matched VGA monochrome monitors includes an overview by contributing editor Winn L. Rosch that describes the evolution of this alternative to VGA color.

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After Hours

Products for the Leisure Side of Personal Computing

Accolade Turbocharges Test Drive With More Play Choices, Optional Scenery

GAMES
by Philip F. H. Rose

Many PC gamers became addicted to *Test Drive*'s combination of slick graphics and a realistic driving simulation; the only thing missing was that new car smell. Rather than retire *Test Drive* to the ranks of computer game classics and forget about it, Accolade and Distinctive Software, the game's designers, have been working for the past year on a sequel: *The Duel: Test Drive II*.

It's comforting to see San Francisco up ahead, but there's a long way to go before the California Challenge is through.

They have smoothed out some of the rough edges and added many new features, creating a superset of the original game. The most significant additions are variable playing-skill levels, optional scenery disks, and an option to race against the computer.

The original *Test Drive*'s scenery was fun. But after 10 or 20 hours of play, the winding mountain road got a little predictable. *Test Drive II*'s scenery covers a wider variety of terrain, including both mountain and valley roads.

Borrowing an idea from its golf games, Accolade has added the option of additional scenery disks to *Test Drive II*. The first disk, released simultaneously with the game, is California Challenge, a trip down the California coast. Along the way, you pass through forests, beaches, and the ubiquitous mountain road. As in the last version, clever details—like the San Francisco skyline—pop up in the scenery from time to time. Whether Accolade will publish more disks is uncertain, but the basic scenery plus the optional California Challenge disk is more than enough to keep you going for quite a while.

While it's still only a one-player game, *Test Drive II* now lets you race against the computer, which adds variety. Less important but welcome additions include a clutch, an indicator of distance traveled, and a cop who is harder to outrun. To shift gears, you now must hold down the Spacebar or joystick fire button (your clutch) while using the arrow keys or joystick to up- or downshift. Or, for a more realistic feel, you can imitate the car's real gearshift with the joystick.

Accolade adopted the idea of variable skill levels from another of its games, *Grand Prix Circuit*. The skill level you select determines the speed of the police car and the computer's car. Lower skill levels free you to concentrate on the road by turning your Lambourghini into an automatic. While serious players will quickly move to the hardest skill level, the easier levels help beginners get started. Some drivers will enjoy the lower levels and never migrate up. This new flexibility is a welcome addition.

The Duel: Test Drive II has greater sensitivity to the road and more realistic handling than the original. Your car's performance degrades if you abuse it by riding on the shoulder, hitting garbage on the road, or bumping other cars. Making too many such mistakes results in breakdowns.

Steering in *Test Drive II* is much tighter and closer to the real thing. It is easier to run off the road or into another car. The handling, however, is sometimes a bit too busy when you use a joystick, and you can't adjust the steering sensitivity.

Unfortunately, Accolade includes a choice of only two cars in *Test Drive II*. The rest, including new ones, are now on the optional Supercars disk. If you want the extra cars, which came standard in the original game, The Supercars disk will run you an extra $19.95.

If you know and love the original *Test Drive*, you will find *The Duel: Test Drive II* a worthy successor. It adds

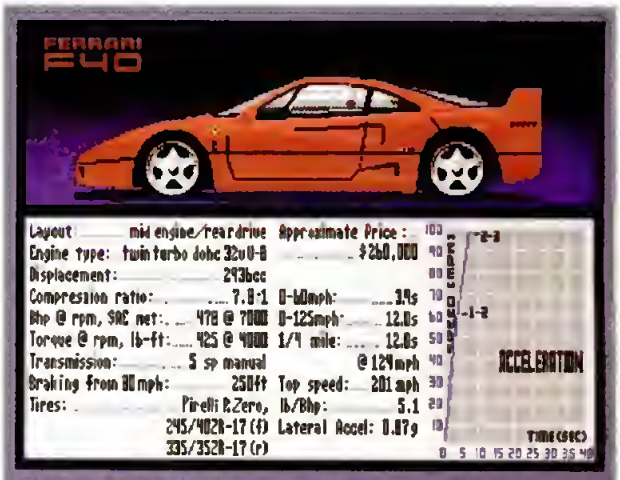
CONTINUED

■ GAMES:
Test Drive II adds scenery and car options.

PC-Fortune and Ask Arniel: give your PC "personality."

Zany Golf and Mini-Putt: Lunacy on the links.

Two games and a database for Dungeons & Dragons fans.



The Duel: Test Drive II comes with the Ferrari F40 and Porsche 959. Five more cars are on the optional Supercars disk.

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enough new features and variations to make you want to play the game all over again.

If you are new to the game, then by all means, go out and buy *The Duel: Test Drive II*. It is one of the highest-quality, most entertaining computer video games ever. The California Challenge scenery disk adds variety and is a recommended addition. If cars are your passion, then the Supercars option disk is in order. If money is no object, $85 buys all three.

List Price: *The Duel: Test Drive II*, $44.95; Supercars, $19.95; California Challenge, $19.95. **Requires:** 512K RAM, graphics adapter, DOS 2.0 or later. Copy protected. Accolade, 550 S. Winchester Blvd., San Jose, CA 95128; (408) 985-1700.

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Two Programs Coax Humor From Your PC

GAMES
by Jonathan Matzkin

Ever since computers first caught our attention, we have tried to give them human personalities. Years ago Kurt Vonnegut wrote a short story about a mainframe that falls in love and then commits suicide. HAL, the on-board computer in Stanley Kubrick's *2001: A Space Odyssey*, didn't respect human life but had the voice, personality, and, alas, the ulterior motives peculiar to Homo sapiens.

Two software packages for the PC attempt, in a modest way, to give your machine a recognizable "personality" in keeping with science-fiction-bred notions about artificial intelligence. *PC-Fortune*, from Jayar Systems, adds a randomly selected witticism to your regular boot-up routine. *Ask Arnie!*, from North American Infonet, generates quotations and answers questions.

PC-Fortune consists of only three files and is designed to be invoked from your AUTOEXEC.BAT file. The command "PCF" outputs an entry from the program's text database of approximately 3,200 entries. You can generate a quote at any time by simply entering PCF at the DOS prompt.

The output varies from one-line jokes or proverbs to paragraph-long observations on the state of reality. You may get something as amusing as "We are confronted with insurmountable opportunities," which is attributed to Pogo, the cartoon philosopher. Or you might face a more sobering thought, like Einstein's observation that "Perfection of means and confusion of ends seem to characterize our age."

Ask Arnie! also offers randomly generated wisdom, but it is more in the vein of newspaper horoscopes. When you start the program, you can choose between asking a specific question or requesting a "prophesy." Both the prophesies and the answers to questions tend to be very general and noncommittal. *Ask Arnie!* would probably be fun to leave running at a party, but its responses lack the wit of *PC-Fortune*'s output.

List Price: *PC-Fortune*, $19.95. **Requires:** 128K RAM, DOS 2.1 or later. Jayar Systems, 253 College St., #263, Toronto, Ontario, Canada M5T 1R5; (416) 751-3284.

CIRCLE 604 ON READER SERVICE CARD

List Price: *Ask Arnie!*, $19.95 plus $5. **Requires:** 256K RAM, DOS 2.0 or later. North American Infonet Inc., P.O. Box 750008, Petaluma, CA 94975; (707) 765-1999.

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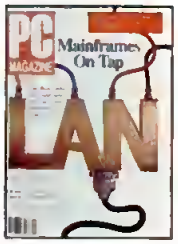

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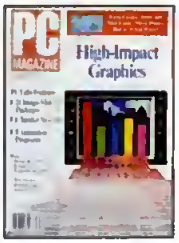

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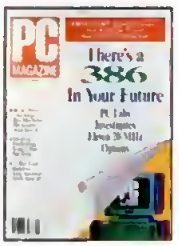

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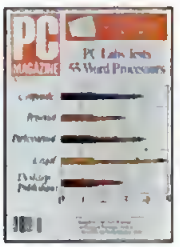

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Miniature Golf Comes to the PC: Beat Par While Avoiding Reality

GAMES
by Jonathan Matzkin

Miniature golf is play therapy for the masses. For an hour or so, you forget the pressing concerns of the larger universe and concentrate instead on the important business of putting through windmills, around corners, and past obstacles of all kinds. *Zany Golf*, from Electronic Arts, and *Mini-Putt*, from Accolade, translate miniature golf onto the screen of your PC.

Miniature golf prospers in the PC environment, since computer animation can blithely ignore the rules of physics, not to mention other components of mundane reality. Designers are free to come up with courses that leave the wildest real-life mini-links far behind. Your ball may respond to a variety of unseen forces as you struggle toward the cup.

Zany Golf is one of the best all-around games ever created for the PC. While it remains faithful to the basic concept of miniature golf, it adds elements of arcade-style action, and leavens the mixture with an extremely warped sense of humor. Each of the nine holes is a unique challenge with as much interest as many standalone arcade games.

Things start off with the traditional "get the ball in the windmill" hole. But from there, the game gets strange. To complete the second hole, you rebound the ball off an enormous bottle of ketchup (which squirts on impact). Once past the ketchup, you must figure out how to dislodge the giant hamburger that rests inconveniently on top of the hole.

Hole four is a stunning graphic representation of a pinball machine, complete with working flippers and bumpers. While you try to figure out how to get outside of the machine and onto the green, you play some fairly realistic pinball.

Zany Golf pulls you into its world with extremely detailed EGA graphics and smooth, lifelike animation. The game supports keyboard, joystick, or mouse controllers; it plays outstandingly with the mouse.

Still, *Zany Golf* isn't perfect. You must begin with the first hole, and you can't go on to the next hole until you finish the current one. If you fail to complete the hole within your limited allotment of strokes, the game ends. That makes for a very high frustration level, as you must enter a code from a copy-protection wheel each time you restart. Each hole has a gimmick to completing it; once you get the trick, the challenge is dissipated.

Accolade's *Mini-Putt* offers more convenience, since you can select any one of the game's holes to practice whenever you choose. You also get a choice of several different courses. And you can continue to hack at a hole for as long as you like; there is no stroke limit per hole.

Play is in some ways as engrossing as that of *Zany Golf*. *Mini-Putt* has some of the same obstacles; there are walls, slopes, and of course the ubiquitous windmill. One hole involves sneaking past an elephant whose trunk blocks the fairway.

Graphically, however, *Mini-Putt* doesn't measure up to *Zany Golf*. Its EGA mode screens are unimpressive. They have a more varied color palette than the game's CGA screens, but they really don't improve on the level of detail. While the windmill is just as hard to get through as the one in *Zany Golf*, it isn't nearly as much fun to look at.

Where *Zany Golf* visually represents changes in slope or terrain, *Mini-Putt* relies on a series of symbols. Arrows, for instance, indicate the direction that the ball will move when it encounters a particular part of the green.

Mini-Putt fares better when it comes to the challenge of play. I found myself utterly stymied by some of the holes, until I had practiced them for quite a while. Proper timing and aim require considerable care. I used the keyboard, which probably isn't as good a controller as the optional joystick. There is no mouse support.

Both *Zany Golf* and *Mini-Putt* enjoyably re-create one of American pop culture's weirdest outgrowths. You can spend hours of relaxation (frustration?) playing either. *Zany Golf* gets the nod, however, for its eye-popping graphics and imaginative design.

Mini-Putt offers plenty of challenge, often in unexpected forms. Its graphics, however, aren't as sharp as those in *Zany Golf*.

Zany Golf is resolutely and delightfully weird in conception, and the design is rendered in sparkling EGA resolution.

List Price: *Zany Golf*, $39.95.
Requires: 384K RAM; EGA, VGA, or Tandy 16 color graphics adapter; DOS 2.0 or later. Copy protected through documentation. Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404. (415) 571-7171.

CIRCLE 423 ON READER SERVICE CARD

List Price: *Mini-Putt*, $14.95.
Requires: 256K RAM, graphics adapter, DOS 2.0 or later. Copy protected. Accolade, 550 S. Winchester Blvd., San Jose, CA 95128; (408) 985-1700.

CIRCLE 424 ON READER SERVICE CARD

SSI Conjures D&D Software

GAMES
by Barry Brenesal

SSI, well known for fantasy and wargaming software, recently joined forces with TSR, creators of Advanced Dungeons & Dragons games, hooks, and paraphernalia. The relationship has borne fruit in the form of two new PC adventure games and a Dungeons and Dragons database that aids in the development of game scenarios for noncomputerized play.

DragonLance: Heroes of the Lance is based upon AD&D's *Dungeons of Despair*. The game's combination of strategy and arcade action is relatively new to the U.S., though already enormously successful in Japan. You use the keyboard to control the various protagonists' actions in real time as the characters battle everything they come across.

There are six predefined fighters and "magic casters." They confront hordes of men, trolls, giant spiders, spectral minions, Bozak Draconians, and sundry riffraff that inhabit Krynn's defiled Xak Tsaroth temple.

A tap of the Spacebar brings up screens that allow you to exercise additional options; you can switch characters, activate devices, and manipulate your surroundings in several ways.

Heroes of the Lance is generally successful. Both CGA and EGA modes offer good use of available colors, and the line drawing is better than most I've seen outside the higher-resolution black-and-white mode. Character movement and scrolling are particularly well handled. Weapons, magic, and surroundings reflect the diversity and imagination one expects from SSI and AD&D.

There are, however, several significant bugs in the IBM translation. Ranged combat worked only three times during six playing sessions. Occasionally during close combat the characters froze, less as a result of magic than of program malfunction. A few of the entryways didn't perform properly, depositing me briefly on an unoccupied title screen. Most annoyingly, *Heroes* refused (unlike other SSI products) to return the user to DOS. To leave the game, you must reboot.

With *Forgotten Realms, Volume I: Pool of Radiance*, however, we are on firmer ground. This multicharacter strategic role-playing fantasy is the sort of adventure SSI has become famous for. The game leads you on magical quests, introduces you to a land and its people, and gives you plenty of time to mull every move.

From six races and nine ethical alignments, you create six characters. Two more (controlled by the computer) may be added later. Monsters, spells, and other items are all familiar to AD&D followers. They aren't really more distinctive than those found in the very fine non-AD&D *Wizard's Crown*, *Phantasie*, and *Questron* series, however.

Only a few relatively complex parts of the game require mapping, which comes as a decided relief.

The pace could definitely be faster. In a departure from previous SSI software, all combat must be resolved tactically. After killing your first 50 kobolds, you don't care if you ever see one again. Nor can the speed be adjusted prior to conflict. It can only be adjusted when you pause to "make camp" in the adventure.

Kobolds are among the beings you do combat with in SSI's *Forgotten Realms, Volume One: Pool of Radiance*. All combat must be resolved tactically.

You're never sure whether the next encounter will feature an unfathomable nasty you'll want to study or just several thousand more kobolds and a couple of game-show hosts.

This aside, *Pool of Radiance* is a winner. Though not as endlessly varied as *Wizard's Crown* or *Eternal Dagger*, it offers far superior graphics, and an intriguing storyline. The game runs on dual floppy drive systems, but I recommend a hard disk, as the program takes up 1.5 megabytes of disk space.

Those addicted to the noncomputerized, multiplayer scenarios in TSR's acclaimed series will find that *Dungeon Master Assistant, Volume I: Encounters* hastens the otherwise lengthy process of encounter development. This database (it's not a game) is exhaustive to use, generating more than 1,000 potential encounters and 1,300 monsters/characters. It takes into account weapons, spells, treasure, and armor. New monsters may be created and stored. I look forward with trepidation to a future volume of the program which encloses a *Microsoft Excel* spreadsheet for tracking cash-flow amidst dragon hoards. ■

***Dungeon Master Assistant, Volume I: Encounters* is a database that aids in the development of D&D scenarios.**

List Price: *DragonLance: Heroes of the Lance*, $39.95. **Requires:** 384K RAM, CGA or EGA graphics, DOS 2.1 or later. Copy protected through documentation.

CIRCLE 425 ON READER SERVICE CARD

List Price: *Forgotten Realms, Volume I: Pool of Radiance*, $49.95. **Requires:** 384K RAM; CGA, EGA or Tandy 16 color graphics; DOS 2.1 or later. Copy protected through documentation.

CIRCLE 426 ON READER SERVICE CARD

List Price: *Dungeon Master Assistant, Volume I: Encounters*, $29.95. **Requires:** 384K RAM, DOS 2.0 or later. Copy protection through documentation. Strategic Simulations, Inc. 1046 N. Rengstorff Ave., Mountain View, CA 94043; (415) 964-1353.

CIRCLE 427 ON READER SERVICE CARD

by Bill Howard

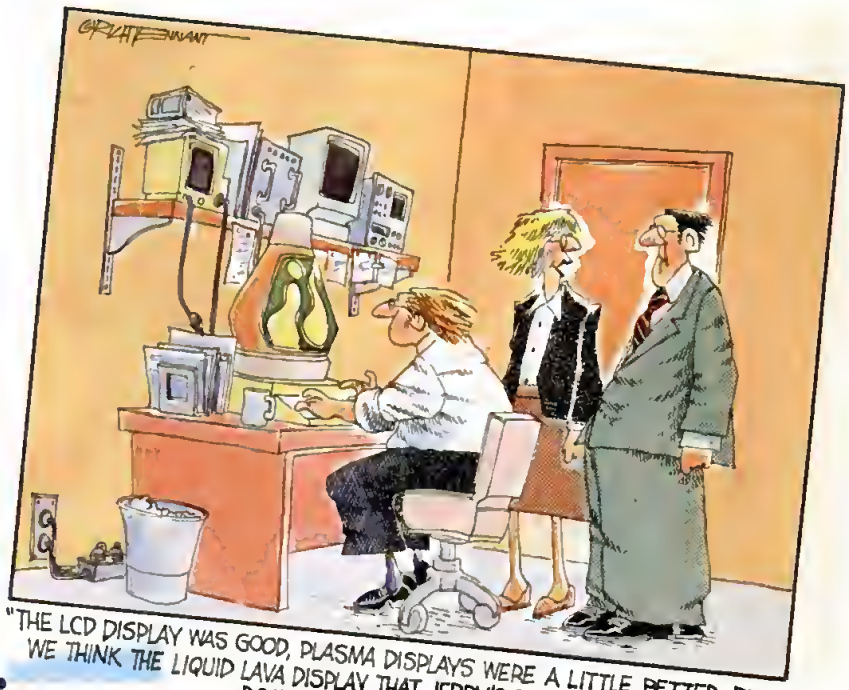
Abort, Retry, Fail?

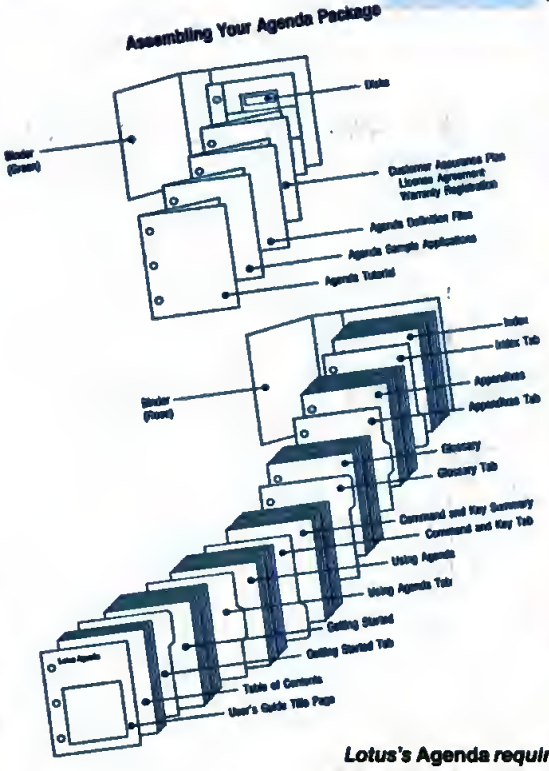
The Lighter Side of Personal Computing

Unfinished Business

For every two steps forward, the industry takes one step backward. Unfinished Business salutes the loose ends of hardware and software design.

Some assembly required: Software companies charge several hundred dollars for their programs, then expect *you* to assemble the documentation binder, divider sheets, and manual pages (even though the boxes may be packed offshore to take advantage of cheap labor). Lotus manuals are so complex, you get a separate sheet to figure out how it all goes together.





Lotus's* Agenda *requires a reference manual explaining how to put together the reference manual.

ILLUSTRATION: RICHARD TENNANT

Amazing Facts

"The two unique products that make the Year of the Brain-Worker inevitable are Persoft's Ize and Calera Recognition Systems' Truescan. The last ingredient is WORM (write-once read-many) drives—or erasable CD storage."

—InfoWorld, *January 9, 1989*

Did He Check AUTOEXEC.BAT?

"Even under straight DOS, it's easy for installation programs to upset the applecart. One of them blew away a staff member's PATH command in his CONFIG.SYS, for which he did not have a recent backup."

—PC Week, *April 10, 1989*

do.) You should be able to pronounce "SQL Server." Know how to open Windows. Understand the impotance of OS/2. And generally hold your own with some of the smartest

"Impotance of OS/2" is a clear misspelling in this Seattle Times want ad for Microsoft (January 15, 1989)—but of which word?

Send entries to Abort, Retry, Fail? (formerly Communiqués). Winners get $50 and a *PC Magazine* T-shirt. Please mark the funny part but don't deface an original (use a photocopy or Post-it). In case of duplicate entries, award goes to the first or the most legible entry. Winners this issue: Bob Walthers (OS/2 "impotance"), B. L. Soucy (erasable WORMs), Bob Stephan (PATH).

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"The new top-of-the-line Dell System 325 is a flagship worth putting out in front of the fleet."

February 14, 1989

For the full story, see inside back cover.